NEW SERIES

SELECTED WATER RESOURCES ABSTRACTS

VOLUME 1, NUMBER 11B
NOVEMBER 15, 1968

WR 68-01020 WR 68-02256

NEW SERIES

Selected Water Resources Abstracts is published semimonthly for the Water Resources Scientific Information Center (WRSIC) by the Clearinghouse for Federal Scientific and Technical Information (CFSTI) of the Bureau of Standards, U. S. Department of Commerce. It is available to Federal agencies, contractors, or grantees in water resources upon request to: Manager, Water Resources Scientific Information Center, Office of Water Resources Research, U. S. Department of the Interior, Washington, D. C. 20240.

CLEARINGHOUSE
FOR FEDERAL SCIENTIFIC AND TECHNICAL INFORMATION

SELECTED
WATER RESOURCES ABSTRACTS

A Semimonthly Publication of the Water Resources Scientific Information Center,
Office of Water Resources Research, U.S. Department of the Interior

VOLUME 1, NUMBER 11B
NOVEMBER 15, 1968

Use of funds for printing this publication approved by the Director of the Bureau of the Budget, September 4, 1968.

UNITED STATES DEPARTMENT OF THE INTERIOR
STEWART L. UDALL, Secretary

OFFICE OF WATER RESOURCES RESEARCH
Roland R. Renne, Director

WATER RESOURCES SCIENTIFIC INFORMATION CENTER
Raymond A. Jensen, Manager

FOREWORD

Selected Water Resources Abstracts, a semimonthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. The contents of these documents cover the water-related aspects of the life, physical, and social sciences as well as related engineering and legal aspects of the characteristics, conservation, control, use, or management of water. Each abstract includes a full bibliographical citation and a set of descriptors or identifers which are listed in the **Water Resources Thesaurus** (November 1966 edition). Each abstract entry is classified into ten fields and sixty groups similar to the water resources research categories established by the Committee on Water Resources Research of the Federal Council for Science and Technology.

Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources. WRSIC is not presently prepared to furnish loan or retention copies of the publications announced.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several planned services of the Water Resources Scientific Information Center (WRSIC). The Center was established by the Secretary of the Interior and has been designated by the Federal Council for Science and Technology to serve the water resources community by improving the communication of water-related research results. The Center is pursuing this objective by coordinating and supplementing the existing scientific and technical information activities associated with active research and investigation program in water resources.

To provide WRSIC with input, selected organizations with active water resources research programs are supported as "centers of competence" responsible for selecting, abstracting, and indexing from the current and earlier pertinent literature in specified subject areas. Centers, and their subject coverage, now in operation are:

- Ground and surface water hydrology at the Water Resources Division of the U.S. Geological Survey, U.S. Department of the Interior.
- Metropolitan water resources management at the Center for Urban Studies of the University of Chicago.
- Eastern United States water law at the College of Law of the University of Florida.
- Policy models of water resources systems at the Department of Water Resources Engineering of Cornell University.
- Water resources economics at the Water Resources Research Institute of Rutgers University.
- Eutrophication at the Water Resources Center of the University of Wisconsin.
- Water resources of arid lands at the Office of Arid Lands Studies of the University of Arizona.

The input from these Centers, and from the 51 Water Resources Research Institutes administered under the Water Resources Research Act of 1964, as well as input from the grantees and contractors of the Office of Water Resources Research and other Federal water resources agencies with which the Center has agreements becomes the information base from which this journal is, and other information services will be, derived; these services include bibliographies, specialized indexes, literature searches, and state-of-the-art reviews.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
Office of Water Resources Research
U.S. Department of the Interior
Washington, D. C. 20240

CONTENTS

FOREWORD_____iii

SUBJECT FIELDS AND GROUPS

(Use Edge Index on back cover to Locate Subject Fields and Indexes in the journal.)

01 NATURE OF WATER
Includes the following Groups: Properties; Aqueous Solutions and Suspensions

02 WATER CYCLE
Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION
Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL
Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Non-Water Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION
Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING
Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA
Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

08 ENGINEERING WORKS
Includes the following Groups: Structures; Hydraulics; Hydraulic Machinery; Soil Mechanics; Rock Mechanics and Geology; Concrete; Materials; Rapid Excavation; Fisheries Engineering.

09 MANPOWER, GRANTS, AND FACILITIES
Includes the following Groups: Education—Extramural; Education—In-House; Research Facilities; Grants, Contracts, and Research Act Allotments.

10 SCIENTIFIC AND TECHNICAL INFORMATION
Includes the following Groups: Acquisition and Processing; Reference and Retrieval; Secondary Publication and Distribution; Specialized Information Center Services; Translations; Preparation of Reviews.

SUBJECT INDEX

AUTHOR INDEX

ORGANIZATIONAL INDEX

ACCESSION NUMBER INDEX

SELECTED WATER RESOURCES ABSTRACTS

01. NATURE OF WATER

1A. Properties

CHEMICAL GEOHYDROLOGY,
U. S. Geological Survey, Water Resources Div., Menlo Park, Calif.
For primary bibliographic entry see Field 02K.
For abstract, see .
W68-01263

1B. Aqueous Solutions AND Suspensions

EFFECT OF TALLOW ALCOHOL ADDED TO SOIL ON THE TENSION, FLOW, AND EVAPORATION OF SOIL WATER,
Procter and Gamble Co., Cincinnati, Ohio.
For primary bibliographic entry see Field 02G.
For abstract, see .
W68-01173

02. WATER CYCLE

2A. General

HYDROLOGICAL YEAR-BOOK OF ISRAEL 1965/66.
Israel Ministry of Agriculture, Jerusalem.

Israel Hydrological Service, Jerusalem, 121 p, 1968.

Descriptors: *Hydrologic data, *Streamflow, *Groundwater, *Water levels, *Water quality, Data collections, Hydrographs, Peak discharge, Low flow, Surface waters, Gaging stations, Aquifers, Springs, Lakes, Saline lakes.
Identifiers: *Periodic observations, Israel.

Hydrological and chemical data for gaging stations of rivers, wadis, springs, and lakes for the period Oct 1965 to Sept 1966 are presented. Groundwater data are summarized in a map showing water levels and salinity contours in the aquifers in the Coastal Plain and Foothills Area in autumn 1967. The 1965-66 precipitation and runoff were slightly below the 10-yr average at all stations. (Knapp-USGS)
W68-01119

DISPERSION OF MASS IN OPEN-CHANNEL FLOW,
Colorado State Univ., Fort Collins.
For primary bibliographic entry see Field 08B.
For abstract, see .
W68-01129

HYDROLOGIC AND CLIMATOLOGIC DATA, 1967, SALT LAKE COUNTY, UTAH,
U. S. Geological Survey.
A. G. Hely, R. W. Mower, and C. A. Horr.
U S Geol Surv Utah Basic-Data Release No 15 (Open-File Release), 74 p, 1968. 5 fig, 1 plate, 62 tab, 16 ref.

Descriptors: *Data collections, *Hydrologic data, *Groundwater, *Streamflow, *Precipitation (Atmospheric), Utah, Air temperature, Water levels, Stream gages, Gaging stations, Discharge (Water).
Identifiers: Salt Lake County, Utah, Periodic observations.

Basic data collected in a study of the hydrology and climate of Salt Lake County, Utah are tabulated. Interpretive work is in a separate report. Climatological station descriptions include location, elevation, and type of data collected. Monthly precipitation, monthly air temperature, monthly pan evaporation, and wind movement are tabulated. Records of selected wells include water levels, drillers' logs, estimated discharge, and chemical analyses. Chemical analyses and suspended sediment loads of streams sampled near gaging stations are compiled. Streamflow records for the water yr 1966-67 are tabulated. A map scaled about 2 miles per in. shows location of hydrologic and climatologic data-collection sites for 1967. (Knapp-USGS)
W68-01135

OPTIMIZING CONJUNCTIVE USE OF SURFACE WATER AND GROUNDWATER,
Utah State Univ., Logan.
Calvin G. Clyde, Bartell C. Jensen, and James H. Milligan.
Proc Symp Groundwater Develop in Arid Basins, Utah State Univ., Logan, pp 59-86, Mar 1967. 28 p, 6 fig, 8 ref.

Descriptors: *Linear programming, *Conjunctive use, *Optimization, *Surface-groundwater relationships, Parametric hydrology, Planning, Water resources development, Water management (Applied), Seasonal, Recharge, Benefits, Hydrologic data, Irrigation, Groundwater, Reservoir operation.
Identifiers: Parametric linear programming, Primal output, Dual output.

A linear programming model was used to find the optimum conjunctive use of surface water and groundwater in a hypothetical existing irrigation system. A hydrologic model, using deterministic inputs equal to mean annual wet season and dry season values, was described and shown in flow diagrams. The objective was to maximize the total net benefits for the system subject to wet and dry season demand and supply constraints, hydraulic continuity constraints, and capacity constraints for various groundwater levels and recharge facilities. Example outputs for the model (e.g. 'primal', 'dual', 'reduced cost', 'dual ranges', 'primal ranges') were tabled and discussed. Example results of a parametric analysis were graphed and explained. Further extensions such as stochastic and nonlinear programming were proposed.
W68-01155

SUPPLY.
Arizona Interstate Stream Commission, Phoenix.
For primary bibliographic entry see Field 03B.
For abstract, see .
W68-01181

HYDROLOGIC DATA: 1966; VOLUME 3--CENTRAL COASTAL AREA, APPENDICES A-E.
California Department of Water Resources.

Calif. Dep. of Water Resources Bull No 130-66, Vol 3, 193 p, May 1968. 3 fig, 3 plate, 21 tab, 5 append.

Descriptors: *Data collections, *Groundwater, *Surface waters, *Water quality, *Hydrologic data, Climatic data, Water wells, Water levels, Gaging stations, California.
Identifiers: Central Coastal Area, California.

Hydrologic data collected in 1966 for the Central Coastal Area of California are presented. Tables show data on climate, surface water flow, groundwater levels, and surface and groundwater quality. Figures show fluctuation of water levels in wells, specific conductance at 5 stations, and status of sea water intrusion in the Santa Clara Valley East Bay area. Plates show location of climatological stations, groundwater basins or units, and surface water measurement and quality stations. Data on water imported to the report area, daily maximum and minimum tides, and corrections to previously published reports are included. (Knapp-USGS)
W68-01259

HYDROLOGIC DATA: 1966; VOLUME V--SOUTHERN CALIFORNIA, APPENDICES A-C.
California Department Water Resources.
Calif Dep of Water Resources Bull No 130-66, Vol V, 486 p, Apr 1968. 19 fig, 7 tab, 3 append.

Descriptors: *Data collections, *Groundwater, *Surface waters, *Water quality, *Hydrologic data, Climatic data, Water wells, Water levels, Gaging stations, California, Recharge.
Identifiers: Southern California.

Hydrologic data collected in 1966 for Southern California are presented. Tables show data on climate, surface water flow, and groundwater levels. Figures show fluctuation of water levels in wells. Plates show location of climatological stations, groundwater basins or units, and surface water measurement and quality stations. Data on water imported to the report area are presented in the surface water section. Artificial recharge activities are reported. (Knapp-USGS)
W68-01260

2B. Precipitation

SOURCES OF ERROR IN CALCULATING THE KINETIC ENERGY OF RAINFALL,
U. S. Dept. of Agriculture, Urbana; Illinois State Water Survey, Champaign; Illinois Univ., Urbana.
J. S. Rogers, L. C. Johnson, and D. M. A. Jomes.
J Soil and Water Conserv, Vol 22, No 4, pp 140-142, July-August 1967. 3 p, 2 fig, 4 tab.

Descriptors: Rainfall disposition, *Kinetics, *Raindrops, *Rainfall, intensity, Variability, Photography, Energy equation, Wind velocity, Analytical techniques.
Identifiers: Soil loss equation.

To more accurately measure rainstorm characteristics, particularly drop-size distribution, falling raindrops were photographed with a 35-millimeter camera and diameters of each drop image measured. The largest raindrop measured was 6.2 millimeters in equivalent diameter. Ignoring drops smaller than 0.5 millimeter did not introduce serious error in calculating total volume of rainfall or kinetic energy of a rainstorm. Error is greatest at low intensities and least at high intensities. Although regression of median volume drop-size on rainfall intensity yielded a highly significant correlation, only 51% of the variation was explained. There may be considerable error in predicting median volume drop-size from rainfall intensity for individual minutes of rainfall. Intensities calculated from drop-size measurements were used to calculate kinetic energies by the Wischmeir-Smith method. Variations from mean drop-size distribution may cause large errors in calculating raindrop kinetic energy for short intervals within a storm. Influence of wind on kinetic energy is as important if not more so than variations in drop-size distributions. (Blecker-Ariz)
W68-01089

ARID-ZONE AGROMETEOROLOGY IN INDIA,
Meteorological Office, Poona, India.
A. K. Mallik.
Agr Meterol, Vol 3, No 1/2, pp 3-34, February 1966. 32 p, 18 fig, 4 tab.

Descriptors: Rainfall, Climatology, Temperature, Solar radiation, Evaporation, Wind velocity, Storms, Crops, Livestock, Agriculture, Land use, Arid climates, Geographical regions, Water resources development, Water utilization, Saline soils, Technology, Irrigation.
Identifiers: *Agrometeorology, Agro-technical methods, India.

Areas with a normal annual rainfall of less than 500 mm have been considered as arid regions in India. A geographic-climatological outline which included geography, climatology, rainfall, temperature, sunshine, radiation, evaporation, wind, thunderstorms, dust storms and hail storms was given for the area under study. A description of agricultural patterns, forms, settlement, main crops, livestock and agro-technical methods was discussed. The available water and its utilization for

agriculture, methods of conservation of rainfall, methods or irrigation and problems of soil salinity were considered together with the climatic interaction between the region and its surrounding area. Methods of protection against wind, raising sand, dust and frost were studied along with the pests and diseases that were favored by the climatic conditions of the area. A survey of the agro-meteorological tasks lying ahead included the augmentation of the water supply, afforestation and soil conservation, maximum use of available water, crop farming verses animal farming, and the role of the agrometeorolgist in arid zones. (Blecker-Ariz.)
W68-01171

THE ADJUSTMENT OF RADAR ESTIMATES OF STORM MEAN RAINFALL WITH RAIN GAGE DATA,
Illinois State Water Survey, Urbana, Illinois.
F. A. Huff.
J of Applied Meteorology, Vol 6, No 1, pp 52-56, Feb 1967. 5 p, 3 fig, 2 tab.

Descriptors: *Radar, *Rainfall, *Rain gages, *Equations, Climates, Regression analysis, Storms.

The study was concerned with an evaluation of a technique which uses the adjustment of radar estimates of areal mean rainfall through the use of available surface rain gage data in the region of interest to modify the radar-rainfall equation for specific conditions. Radar estimates of storm mean rainfall on the two dense rain gage networks in Illinois and Oklahoma were obtained through use of the equation of Marshall and Palmer. The data from the two network and radar sets were found to be represented satisfactorily by a single regression line. The normal climatic network was inadequate for modification of the radar equation in warm-season storms in the Midwest if a relatively accurate estimate of storm mean rainfall is needed. The results of the evaluation study indicated that appreciable improvement in radar estimates of storm and monthly rainfall could be achieved through the use of surface rain gage data to modify the radar equation based upon average Z-R (Marshall and Palmer equation) for specific storm conditions. The inherent limitations in the rain gage adjustment method were discussed. (Blecker-Ariz.)
W68-01180

CONDITIONAL PROBABILITY OF OCCURRENCE FOR VARIATIONS IN CLIMATE BASED ON WIDTHS OF ANNUAL TREE RINGS IN ARIZONA,
Arizona Univ, Laboratory of Tree-Ring Research, Tucson.
Charles W. Stockton, and Harold C. Fritts.
Environ Sci Serv Admis Annu Rep, 24 p, Jan 10, 1968. 7 fig, 15 tab.

Descriptors: *Dendrochronology, *Climatology, *Paleoclimatology, *Statistical methods, *Correlation analysis, Frequency analysis.
Identifiers: Tree-ring paleoclimatology.

Several methods of correlating tree ring widths with climatic data were tested statistically. Climatic data for Arizona, including both precipitation and temperature for four seasons, are divided into three equally probable classes. Several ring-width chronologies were standardized, normalized, and combined into a single state-wide series. High and low frequency variance components are analyzed to evaluate intervals of heterogeneity in ring width throughout the state for twenty yr time intervals. The use of three precipitation and three temperature classes produces a population with nine categories which are combined with nine equally probable ring width classes. Probabilities for each combination of climatic and ring class are established. A chi-square test for independence and coefficients of contingency confirmed the existence of significant relationships. Probability statements about seasonal climatic classes prior to the 1900-1947 base period may be written. (Knapp-USGS)
W68-01251

PRECIPITATION CLIMATOLOGY OF LAKE MICHIGAN BASIN,
Illinois State Water Survey, Urbana, Illinois.
Stanley A. Changnon, Jr.
Ill State Water Survey Bull 52, Urbana, 1968. 46 p, 40 fig, 17 tab, 49 ref.

Descriptors: *Climatology, *Precipitation (Atmospheric), *Storms, *Lake Michigan, *Weather patterns, Synoptic analysis, Weather, Weather data, Lakes, Lake breezes, Thermal properties, Snow, Rain, Humidity, Climates, Environment.
Identifiers: *Precipitation climatology, Lake-basin climatology.

A detailed climatological study shows that the average annual precipitation over Lake Michigan is 6% less than that over the land portion of the basin. On the average the basin receives 700 billion gal less than if the average lake precipitation were the same as that over the land areas. Lake effects suppress summer thunderstorm activity by 20% over the southern end of the lake, but increase fall activity by 50%. There are 400% more fall hail days over the lake than in surrounding areas. The lake also caused 25 to 100% more snowfall and days of heavy snow along the eastern shore than along the western shore. Average annual snowfall is 33% greater on the east than the west side. Thunderstorm precipitation averages 10% higher on the west than the east shore. Average lake precipitation in summer is 8.4 in., 14% lower than the surrounding area. Average winter lake precipitation is 5.4 in., 4% higher than the surrounding land area. Spring precipitation is 7.4 in., 7% less than the surroundings, and fall precipitation 8.4 in., equal to the land average. The lake annual average precipitation is lowest--less than 27 in.--in the west-central part, and highest in the southeast and northeast. The lake average precipitation is 29.6 in. (Knapp-USGS)
W68-01254

2C. Snow, Ice, AND Frost

FLUVIAL PROCESSES IN THE HIGH ARCTIC,
Canada Department of Energy, Mines and Resources, Ottawa, Canada.
Frank A. Cook.
Geog. Bull, vol 9, no 3, pp 262-268, 1967. 7 p, 3 fig, 3 tab, 11 ref.

Descriptors: *Arctic, *River flow, *Snowmelt, *Runoff, Permafrost, Erosion.
Identifiers: *Mecham River, *Cornwallis Island.

The runoff characteristics of the Mecham River near Resolute, Cornwallis Island, are considered in relation to a general discussion of some aspects of fluvial processes in high Arctic regions, in view of the fact that the erosional role of high melting snow in these regions has been generally underestimated. The area concerned is arid and underlain by permafrost to a depth of some 1,300 ft, with the active layer thawing to approximately 2 ft during the short summer season. On the basis of quantitative measurements, it is postulated that the intense spring freshet from rapidly melting snow is responsible for the bulk of transport of weathered material, in solution, suspension, and by saltation. Rainfall at Resolute averages less than 3 in./yr, and individual shower intensity is very low. Nearly 89% of all showers totalled less than the critical amount, and only 2 or 3 times a yr heavy summer rainfall acts as an erosiive agent. Tabulated runoff data are based on the one parameter of maximum daily velocity, which under these special conditions are more reliable than runoff volume totals. (Llaverias-USGS)
W68-01029

DEVELOPMENT, LANDFORMS AND CHRONOLOGY OF GENERATOR LAKE, BAFFIN ISLAND, N W T,
Canada Department of Energy, Mines and Resources, Ottawa, Canada.
D. M. Barnett.
Geogr Bull, Vol 9, No 3, pp 169-188, 1967. 20 p, 13 fig, 1 tab, 32 ref.

Descriptors: *Geomorphology, *Proglacial lake environment, *Generator Lake, *Deglaciation, Groundwater basins, Watershed (Basins), Particle size analysis, Glacial geomorphology, Glacial drift.
Identifiers: Glacial retreat, Chronology, Lichenometric dating, Baffin Island.

This proglacial lake had 2 main phases of evolution, over a 1,500-yr period, during the 26-km retreat of the ice margin. Further retreat accounted for the draining of the lake by a new outlet into Clyde River and a fall in lake level of 75 m. The next retreat continued for another 5 km to the present ice cliffs; the 1948-66 period was characterized by very active retreat, averaging 25 m/yr. At their highest peak, the present ice cliffs rise more than 17 m above lake level. Landforms developed in the proglacial lake environment, exposed when the former lake drained, are: the shoreline, ice-pushed ridges, deltas, cross-valley moraines, and a terrace. Stratigraphic relationship between the moraine and terrace suggests a subglacial orgin in the case of moraines. A similar set of landforms are developing in the present lake. Critical review of lichenometry emphasizes that caution should be exercised when applying this useful dating technique near the upper size limit of a species. A provisional chronology of the last 1,500 yr is proposed; this includes draining the lake between 950 and 750 yr ago, and non-deformation of shoreline. (Llaverias-USGS)
W68-01035

HYDROLOGY OF THE LEWIS GLACIER, NORTH-CENTRAL BAFFIN ISLAND, N W T, AND DISCUSSION OF RELIABILITY OF THE MEASUREMENTS.
Canada Department of Energy, Mines and Resources, Ottawa, Canada.

Geog Bull, Vol 9, No 3, pp 232-261, 1967. 30 p, 11 fig, 11 tab, 14 ref.

Descriptors: *Snowmelt, *Runoff, *Watersheds, *Glaciers, Microclimatology, Snowmelt, Rainfall.
Identifiers: *Lewis Glacier, *Baffin Island, *Glacio-hydrology, Water budget, Ablation, Error analysis.

Water budget studies summarize hydrological conditions of the Lewis Glacier watershed for 3 yr differing in runoff, snowmelt, microclimatology, and certain other significant parameters. Error analysis show that maximum discrepancies of runoff as high as plus 67% or minus 21% might be contained in the data, but that the actually sustained discrepancies were less than 10% standard deviation. Reasonable values of glacier net budget can be estimated from water budget accounts. The sensitivity of the watershed to available heat, expressed as deg-hr, is used to account for the behavior of runoff as the season progresses and melting proceeds on the glacier; thereby, runoff is related to wather conditions. The glacier comprises 88.8% of the watershed, and the 1963 glacier melt registered a high value. Runoff for 1963 and 1964 was characterized by storm peaks and little seasonal trend. (Llaverias-USGS)
W68-01041

NONSTEADY COMPRESSIBLE FLOW THROUGH ANISOTROPIC POROUS MEDIUMS WITH PARTICULAR REFERENCE TO SNOW,
U. S. Army Cold Regions Research and Engineering Lab., Hanover, N. H.
S. S. T. Farr, and Yin-Chao Yen.
Water Resources Res, Vol A, No 3, pp 597-606, June 1968. 10 p, 6 fig, 12 ref.

Descriptors: *Unsteady flow, *Porous media, *Snow, Mathematical studies, Compressible flow.
Identifiers: *Anisotropic snow layer, Dimensionless variables, Isothermal flow, Ideal gas behavior.

Findings of previous investigations were extended to the case of snow with nonuniform permeability and a gas characterized by van der Waal's equation of state. Equations describing the unsteady flow of air through an anisotropic layer of snow are solved numerically. It was found that even at a moderate boundary pressure of 2 atm, the penetration of the pressure front becomes appreciably more damped, and the rate of propagation reduces, in the case of van der Waal's equation as compared with the case of ideal gas. For pressures of 5 and 50 atm, these differences are accentuated. The assumption of ideal gas behavior could lead to error, and care must be taken when dealing with problems of compressible fluid flow through porous mediums. (Laverias-USGS)
W68-01128

SPRING SLOPE RUNOFF FROM THE PRINCIPAL AGRICULTURAL LANDS OF THE KULUNDA STEPPE,
USSR Academy of Sciences, Novosibirski, Institute of Hydrodynamics, Siberian Branch.
M. I. Bayusheva.
Soviet Soil Sci, Vol 4, pp 399-405, April 1966. 7 p, 1 fig, 2 tab.

Descriptors: *Cultivation, *Runoff, Snowpacks, Snowmelt, Temperature, Precipitation, *Soil moisture, *Fallowing, Overland flow, Snow, Solar radiation, Interception, *Saline soils.

An experiment to study the influences of the most commonly used surface cultivation methods on the amount of slope melt runoff was conducted in Northern Kulunda in a zone of inadequate moisture. Data was taken on air temperature, precipitation, determination of soil moisture content in individual plots, the amount of water in the snow and a measurement of melt water runoff from the plots. Variations in the water content in the snow per layer occurred on land plowed without a moldboard and clean fallow plot. The flow of water from the snow and the runoff from the plots took place in expressed daily waves due to the solar type of weather. The amount of surface runoff of melt waters depended greatly on the type of agricultural cultivation of the soil. The melt waters were most intensively intercepted on plots which had been plowed with and without a moldboard across a slope of a fall-plowed field. The highest runoff coefficients were observed with non-shallow-plowed wheat stubble. The results of a field experiment on a study of the slope runoff of melt waters from salinized soils were given. (Blecker-Ariz.)
W68-01174

EFFECTS OF TEMPERATURE AND PRESSURE ON UNFROZEN SOIL WATER,
Purdue Univ., West Lafayette, Ind.
Philip F. Low, Peter Hoekstra, and D. M. Anderson.
Water Resources Res, Vol 4, No 3, pp 541-544, June 1968. 4 p, 2 fig, 1 tab, 9 ref.

Descriptors: *Soil moisture, *Frost, *Ice, *Thermal properties, Temperature, Bentioite, Interfaces, Thermodynamics.
Identifiers: *Unfrozen soil water, *Sodium bentonite, *Adsorption isotherms, Freezing point, Pressure effects.

Thermodynamic methods are presented for calculating, from the water adsorption isotherms, the change in unfrozen water content of a partially frozen soil with temperature at a constant pressure or with pressure at a constant temperature. Then, using pertinent experimental data for Na-Wyoming bentonite, the increase in unfrozen water caused by a confining pressure of 100 atm is obtained as a function of temperature. Such information is shown to be relevant to the mechanical properties of frozen soils under stress. (Llaverias-USGS)
W68-01264

2D. Evaporation and Transpiration

EVAPOTRANSPIRATION AND THE WATER BUDGET OF PRAIRIE POTHOLES IN NORTH DAKOTA,
U. S. Geological Survey.
Jelmer B. Shjeflo.
U S Geol Surv Prof Pap 585-B, 1968. 49 p, 45 fig, 5 tab, 15 ref.

Descriptors: *Evapotranspiration, *Evaporation, *Mass transfer, *Potholes, Aquatic plants, Meteoric water, Playas, Water balance, Seepage, Environmental effects, North Dakota.
Identifiers: *Prairie potholes.

The mass-transfer method was used to study the hydrology of 16 prairie potholes in central North Dakota from 1960-64. Many potholes dried when precipitation was low. Average evapotranspiration from May to October was 2.11 ft and average seepage was 0.60 ft; both were nearly the same in both wet and dry years. The source of most of the water in the potholes was direct rainfall on their surfaces; this was 1.21 ft per yr. Spring snowmelt supplied 0.79 ft and runoff in summer supplied 0.53 ft. Average runoff into one pothole was 1.2 in. per yr--1 in. from snowmelt and 0.2 in. from rainfall. Aquatic plants complicated measurement; new computation procedures had to be used for vegetated potholes. Rating periods were divided into 6-hr units for vegetated potholes and water levels had to be measured with 0.001 ft accuracy. (Knapp-USGS)
W68-01043

STUDIES OF THE DRYING OF BARE GROUND,
Texas A and M University.
Winton Guy Covey, Jr.
Ph D dissertation, 1965. 102 p, 12 fig, 3 tab, 46 ref.

Descriptors: *Drying, Soil, *Thermal properties, *Soil moisture, *Evaporation, Water vapor.
Identifiers: Buckingham effect.

The studies reported were an attempt at a synthesis - an effort to see the thermal and moisture processes in the drying of bare ground as a unified set of natural phenomena. Livington's concept of evaporativity (the weather factors influencing evaporation rate) was analyzed together with the complementary concept of evaporability, the concepts concerning the Buckingham effect and the second stage of drying. The question of the validity and utility of the concepts of limiting factor, rate-limiting process and activation energy in the study of evaporation from soil was examined. Vapor movement upward at the surface went with heat flow into the soil. The complex concept of evaporativity was shown to be necessary, useful and unavoidable in the consideration of the evaporation of water from soil. The general law had been proposed that an increase in evaporativity gave an increase in the rate of evaporation from soil. The 'Buckingham effect' had been shown to occur in the drying of bare ground; this name was proposed for the increased resistance to further drying which is caused by a rapid initial rate of evaporation from a moist soil. (Blecker-Ariz)
W68-01076

OBSERVATIONS ONMICROCLIMATE AND VEGETATION INTERRELATIONSHIPS ON THE ACCRA PLAINS (GHANA),
Ghana Univ., Legon. Department of Botany.
G. W. Lawson, and J. Jenik.
J of Ecology, Vol 55, No 3, pp 773-785, Nov 1967. 13 p, 9 fig, 1 tab.

Descriptors: *Vegetation, *Transpiration, *Dry season, *Climatology, Shrubs, *Grasslands, Trees, Air temperature, Soil temperature, Evaporation, Humidity, Wind velocity, Xerophytes.
Identifiers: Microclimate, Mesophytic.

Measurements of microclimate and transpiration during a complete 24 hour period were carried out on the Accra Plains during the dry season (December 1965 to April 1966). Seven microclimatological stations were set up in a characteristic tree, shrub clump and the surrounding grassland. Hourly records of soil and air temperature, evaporative power of the air, relative humidity, wind speed and wind direction showed marked variations in space and time. The prevailing southwesterly wind effects an ecological differentiation around the clump. The grasses and shrubs on the windward side showed xerophytic features compared with the mesophytic condition of those on the lee of the clump. (Blecker-Arizona)
W68-01077

EVAPOTRANSPIRATION RATES OF FIELD CROPS DETERMINED BY THE BOWEN RATIO METHOD,
U S Dept of Agriculture, Agricultural Research Service, Phoenix.
For primary bibliographic entry see Field 03F.
For abstract, see .
W68-01106

SOME PHYSICAL ASPECTS OF INTERNAL CONTROL OF LEAF TRANSPIRATION,
CSIRO, Canberra, Australia.
R. O. Slatyer.
Agr Metoerol, Vol 3, No 5/6, pp 281-292, Aug 1966. 10 p, 50 ref.

Descriptors: *Transpiration control, Stomata, Leaves, *Cytological studies, *Vapor pressure, Soil moisture, Wilting point, Evaporation, Xylem, Resistance, Plant physiology, Moisture stress, Diffusion.
Identifiers: Gradients.

Two main mechanisms have been proposed to account for non-stomatal transpiration control: incipient drying postulates development of high resistance to vapor movement between actual evaporative surfaces in internal mesophyll cell walls and natural cell wall surfaces; substantial depression of vapor pressure at evaporative surfaces because of solute accumulation or steep local water potential gradients. Evidence is presented suggesting that neither of these mechanisms is likely to occur at soil moisture contents high enough to prevent permanent wilting nor was significant increase in diffusive resistance due to withdrawal of evaporating surfaces into interfibrillar spaces likely. It was also unlikely the water vapor concentration at internal evaporating surfaces was reduced significantly by water potential gradients within the leaf or by solute accumulation at evaporative surfaces. Significant vapor pressure depression seemed improbable partly because (1) relatively high rates of water exchange between cells tended to prevent development of steep local gradients of leaf water potential and (2) excessive solute accumulation at evaporative surfaces was prevented by back diffusion towards xylem terminals. (Affleck-Ariz)
W68-01109

THEORETICAL PREDICTION OF EVAPORATION LOSSES FROM GROUNDWATER,
Unesco College of Engineering, Riyadh, Saudi Arabia.
Aristides Liakopoulos.
Water Resources Res, Vol 2, No 2, pp 227-240, 1966. 14 p, 14 fig.

Descriptors: *Evaporation, *Groundwater, Saturated soils, Soil water movement, Mathematical models, Programming languages, Capillary action, *Equations, Water pressure, *Water loss, Porous media, Soil moisture, Unsaturated flow, Hydraulic conductivity.
Identifiers: Evaporation forecasting, Evaporation intensity.

The physical problem of the capillary rise case investigated theoretically in the study considered a uniform soil 2 meters deep. The soil was initially saturated with water without any excess water on its surface, from which evaporation could take place at a variable rate. The aim was to predict theoretically the evaporation rate, the water distribution, and the pressure distribution of the water at any level of the soil mass over a period of time. The physical problem was reduced to its equivalent mathematical model in terms of a partial differential equation together with its initial and boundary conditions. 18 equations were used to explain evaporation losses. As the intensity of evaporation increased, the loss of water (evaporation rate) increased but as the evaporation proceeded, the rate decreased and became lower than when evaporation proceeded at the lower intensity. Evaporation losses from groundwater can be predicted adequately by solving the diffusion-type equation of water conduction in soils with given initial and boundary conditions. The procedure for the numerous calculations required for numerical integration was programmed in Fortran. (Blecker-Ariz.)
W68-01172

2E. Streamflow and Runoff

MAGNITUDE AND FREQUENCY OF FLOODS IN THE UNITED STATES PART 5. HUDSON BAY AND UPPER MISSISSIPPI RIVER BASIN,
U. S. Geological Survey.
James L. Patterson, and Charles R. Gambel.
U. S. Geol Surv. Water-Supply Pap 1678, 1968. 546 p, 13 fig, 2 tab, 14 ref.

Descriptors: *Floods, *Stage-discharge relations, *Hydrologic data, *Flow characteristics, *Streamflow forecasting, Mississippi River Basin, Regional flood, Maximum probable flood, Discharge measurements, Stream gages, Streams, Gaging stations, Flow measurements, Flow rates.
Identifiers: *Annual flood, *Flood data, *Flood frequencies, Hudson Bay basin, Annual peak stage.

The magnitude and frequency of floods of any recurrence interval between 1.1 and 50 yr were determined for most streams in the Hudson Bay and Upper Mississippi River basins. Flood-frequency curves were defined by gaging-station data. Composite frequency curves showing the relation of the mean annual floods to floods recurring from 1.1 to 50 yr are presented. Other curves show the relation of mean annual flood to basin characteristics. In Montana, North Dakota, and Northwestern Minnesota, only drainage basin size was used as an independent variable, and in the rest of the report area both basin size and lake area were found to be important factors in the magnitude of the mean annual flood. Flood-frequency curves should not be extrapolated beyond the range defined by base data. The regional curves are not applicable to some of the large rivers, which are treated separately. (Knapp-USGS)
W68-01023

ON WAKES IN STRATIFIED FLUIDS,
Johns Hopkins University, Baltimore, Department of Mechanics.
For primary bibliographic entry see Field 08B.
For abstract, see .
W68-01040

STREAMS IN DUTCHESS COUNTY, NEW YORK--THEIR FLOW CHARACTERISTICS AND WATER QUALITY IN RELATION TO WATER PROBLEMS,
U. S. Geological Survey.
For primary bibliographic entry see Field 04A.
For abstract, see .
W68-01042

STREAMFLOW FLUCTUATION, BAR ROUGHNESS, AND BED LOAD MOVEMENT: A HYPOTHESIS,
Oregon College of Education, Monmouth.
Richard B. Noragaard.
Water Resources Res, Vol 4, No 3, pp 647-650, June 1968. 4 p, 1 fig, 4 ref.

Descriptors: *Streamflow, *Bed load, *Channel erosion, *Channels, Beds, Channel morphology, River flow, Roughness (Hydraulic), Scour, Dredging, Sand bars, Columbia River, Deposition (Sediments).
Identifiers: Streamflow fluctuation effects.

A relation between streamflow variables and bar conditions on the Lower Columbia River derived by linear regression analysis on U.S. Army Corps of Engineers and U.S. Geological Survey data leads to the hypothesis that bed-load movement and bar scour are increased by streamflow fluctuation. Net deposition decreased with increased streamflow fluctuation in the study encompassing 28 bars dredged by the Corps of Engineers in the 100-mi reach between Vancouver, Wash., and the ocean. (Knapp-USGS)
W68-01044

WHAT IS DROUGHT,
USGS, Water Resources Division, Menlo Park, Calif.
Walter Hofmann, and S. E. Rantz.
J Soil and Water Conserv, Vol 23, No 3, pp 105-106, May-June 1968. 2p.

Descriptors: *Droughts, Water shortage, Moisture deficit, *Hydrologic aspects, Water year, Climatology.
Identifiers: *Palmer drought index, Agricultural drought.

Drought is a relative term and has no precise, universally acceptable definition. In general terms drought is a sustained period of significantly subnormal water or moisture supply. To define precisely the terms 'sustained period' and 'significantly subnormal supply' is difficult. The geographic distribution of natural elements like climate and soils makes it virtually impossible to apply the same precise definition to all areas. The hydrologist usually thinks of drought in terms of a deficiency in precipitation or runoff. The definitions of hydrologic drought, as used in the US, are given. Agriculturalists are usually concerned with soil-moisture deficiencies as they relate to crop yield. Some investigators consider the water needs for established human activities to be essential criterion for drought conditions. Drought is a 'non-event' or situation as opposed to a distinct event, such as a flood. Until recently, most of the criteria used to identify drought have been arbitrary and subjective. Methods such as the Palmer method are being developed to define drought objectively and classify its severity. (Blecker-Ariz)
W68-01100

FLOOD OF MARCH 24, 1967, KIHEI AND OLOWALU AREAS, ISLAND OF MAUI, HAWAII,
U. S. Geological Survey.
Stuart H. Hoffard.
Hawaii Div of Water and Land Develop Rep R30, 14 p, July 1968. 8 fig, 1 tab, 3 ref.

Descriptors: *Floods, *Historic flood, *Cloudbursts, *Storm runoff, Discharge (Water), Hydrographs, Overland flow, Precipitation (Atmospheric), Water injury, Hawaii, Rainfall intensity.
Identifiers: *Maui, Hawaii.

On Mar 24, 1967, 6 inches of rain fell in 4 hr over the Kihei and Olowalu areas of central and west Maui. The flooding was the most extensive since 1951. Nearly 4 miles of highway in the Kihei area was inundated. The peak discharge at the Kulanihakoi Gulch gaging station was 2,740 cfs, more than 6 times the previous maximum peak for the 1963-67 period of record. The rainfall was estimated to be a 200 yr event. Discharges are tabulated for 17 gaging stations, and hydrographs are drawn for 2 of them. Mass rainfall curves are drawn for 6 stations, and an isohyetal map shows rainfall from 8 a.m. Mar 23 to 8 a.m. Mar 24, 1967, on Maui. (Knapp-USGS)
W68-01133

GENERAL PROCEDURE FOR GAGING STREAMS,
U. S. Geological Survey.
For primary bibliographic entry see Field 07A.
For abstract, see .
W68-01138

METHODS FOR PREDICTING DISPERSION COEFFICIENTS IN NATURAL STREAMS WITH APPLICATIONS TO LOWER REACHES OF THE GREEN AND DUWAMISH RIVERS WASH.,
U. S. Geological Survey.
Hugo B. Fischer.
U S Geol Surv Prof Paper 582-A, pp A1-A27 1968. 27 p, 27 fig, 1 tab, (17 ref).

Descriptors: *Dispersion, *Diffusion, *Convection, *Mixing, *Path of pollutants, Flow, Open channel flow, Dye releases, Tracers, Digital computers, Washington, Streamflow, Waste dilution.
Identifiers: *Dispersion coefficient prediction, Green River, Washington, Duwamish River, Washington, Seattle.

Dye dispersion experiments were conducted in the Green and Duwamish Rivers, Washington. Longitudinal dispersion coefficients were obtained in 2 experiments, lateral concentration variations in the third, and aerial photographs in the fourth. The study reach was a section of meandering river, most of which is affected by tides during a part of the tidal cycle. Dispersion was observed during normal riverflow and tidal reversals. In normal flow of about 300 cfs the observed dispersion coefficient was 70-90 sq ft per sec. In natural riverflow, lateral variation in velocity is hypothesized to be the dominant mechanism for dispersion. With this hypothesis, G. I. Taylor's theory for turbulent dispersion in pipes may be applied to natural streamflow. The resulting analysis predicts a dispersion coefficient of 88 sq ft per sec for a flow of 300 cfs in the Green Duwamish Rivers. A numerical solution to the convective diffusion equation is obtained utilizing a high-speed electronic computer. Analysis of a 2-dimensional flow with logarithmic velocity profile, for which a theoretical result is available, shows that the program produces accurate results. Analysis of the flow in the Green and Duwamish Rivers predicts a dispersion coefficient of 91 sq ft per sec. (Knapp-USGS)
W68-01145

FIELD AND LABORATORY EXPERIMENTAL APPROACHES,
Agricultural Research Service, Riesel, Tex.
Walter G. Knisel, Jr., and Ralph W. Baird.
Pap No 68-215B, Annu Meeting, Amer Soc Agr Eng, Logan, Utah, June 1968. 15 p, 7 fig, 3 ref.

Descriptors: Drainage, Drainage systems, Seepage, Subsurface drains, Discharge measurement, Trenches, Cipolletti weirs, *Groundwater flow, Ground water, *Hydrographs, Rainfall, Water measurement, Observation wells, *Surface runoff, Recording systems, Wells, Vee-notched weirs.
Identifiers: Interception, *Drains, Texas, Surface drainage, Seepage control, Blacklands Exper Watershed, Water level, Base flow.

A terrace channel constructed to drain a seeping area on the Blacklands Experimental Watershed near Riesel, Tex, was instrumented with a weir to measure surface runoff. A gravel trench drain with another weir was installed upslope from the channel to measure ground-water flow. Water-level recorders were installed in observation wells. Ob-

servations of surface flow and ground-water characteristics will be used to test current base-flow separation procedures. Analysis of hydrographs to separate base flow from surface flow is based on simplifying assumptions that have not been tested. This experiment will provide data needed to test the assumptions, or lead to developing a rational method for separating base flow from surface flow. (USBR)
W68-01233

DISSOLVED-MINERAL INFLOW TO GREAT SALT LAKE AND CHEMICAL CHARACTERISTICS OF THE SALT LAKE BRINE: SUMMARY FOR WATER YEARS 1960, 1961, AND 1964,
U S Geological Survey.
D. C. Hahl.
U S Geol Surv Water Resources Bull 10, 1968. 35 p, 17 fig, 15 tab, 26 ref.

Descriptors: *Great Salt Lake, *Dissolved solids, *Streamflow, *Water chemistry, *Saline water systems, *Saline water, Discharge (Water), Aqueous solutions, Limnology, Utah, Arid climates, Duration curves, Water management (Applied), Irrigation water, Saline lakes.
Identifiers: *Conductance-duration, Water availability.

The dissolved-mineral inflow to Great Salt Lake was investigated in 1960 and 1961, which had the lowest recorded streamflow, and in 1964, which had a streamflow very near the long-term average value. In 1960-61, only surfacewater inflow data were collected. In 1964 data were obtained on surface-water inflow near the lakeshore as well as at the same sites used in 1960-61. Inflow near the lakeshore in 1961 was estimated by comparison with 1964 data. The 1964 inflow was about 1,700,000 ac-ft of water and 3,500,000 tons of dissolved solids. The 1961 inflow was about 800,000 ac-ft of water and 2,200,000 tons of dissolved solids. In an average year about 500,000 ac-ft of water from the Bear River and about 90% of the total inflow from the Bear, Weber, and Jordan Rivers are good enough for irrigation. A freshwater lake near the present Great Salt Lake shoreline could contain a water supply of 300,000 to 1,000,000 ac-ft with 800 to 500 ppm dissolved solids in a period of average flow. Records of streamflow and salinity are tabulated, and flow-duration curves are included. (Knapp-USGS)
W68-01249

GEOLOGY AND WATER RESOURCES OF THE HIBBING AREA, NORTHEASTERN MINNESOTA,
U. S. Geological Survey.
For primary bibliographic entry see Field 04B.
For abstract, see .
W68-01267

2F. Groundwater

GROUND-WATER RESOURCES OF CHOWAN COUNTY, NORTH CAROLINA,
U. S. Geological Survey.
For primary bibliographic entry see Field 04B.
For abstract, see .
W68-01024

IDENTIFICATION OF AQUIFER PARAMETERS BY DECOMPOSITION AND MULTILEVEL OPTIMIZATION,
California Univ., Dept. of Eng., Los Angeles.
Y. Y. Haimes, R. L. Perrine, and D. A. Wismer.
Calif Univ Water Resources Center, Contrib No 123, Rep 67-63, 53 p, Mar 1968. 9 fig, 4 tab, list of symbols, 34 ref.

Descriptors: *Aquifer characteristics, *Transmissivity, *Storage coefficient, *Specific yield, *Digital computers, Optimization, Linear programming, Hydrogeology, Water storage, Potentiometric level, Data processing, Computer models, Computer programs.
Identifiers: Aquifer parameters, Digital computer search and optimization methods, Algorithmic computer methods.

A digital computer system for the evaluation of aquifer properties is described. Although the water value is large, it is not economical to extensively sample and test an aquifer. A good method to determine aquifer properties is by identification techniques. Response to known changes is observed and analyzed for likely values of aquifer parameters, primarily transmissibility and storage, which lead to observed behavior. In the system presented, pressure and production data in a multiple well system are used in a continuous line source solution giving a finite number of well images. Adjacent images are symmetrical to an imaginary impermeable separating boundary. Solution of the pressure equation for a single well is expanded to multiple wells. The system model for the distributed parameter system is reformulated in terms of integral equations. Decomposition and multilevel optimization techniques reduce the identification problem and the need of computer memory by trading storage for computer time. The gradient technique and direct search methods are presented as first-level optimization controllers; the Gauss-Seidel algorithm is the second-level controller. A 4-well system example is solved by digital computer. (Knapp-USGS)
W68-01047

EXAMPLES OF RECENT ADVANCES IN ANALYTICAL TECHNIQUES FOR EVALUATING AQUIFERS,
U S Geological Survey, Water Resources Division, Denver.
For primary bibliographic entry see Field 07A.
For abstract, see .
W68-01118

FLOW PATTERN AND RELATED CHEMICAL QUALITY OF GROUND WATER IN THE '500-FOOT' SAND IN THE MEMPHIS AREA, TENNESSEE,
U. S. Geological Survey.
Edwin A. Bell, and Dale J. Nyman.
U S Geol Surv Water-Supply Pap 1853, 27 p, 1968. 5 fig, 4 plate, 2 tab, 14 ref.

Descriptors: *Groundwater, *Municipal water, *Water quality, *Water yield, *Flow rates, Flow nets, Groundwater movement, Artesian wells, Confined water, Drawdown, Hydraulic gradient, Aquifer characteristics, Tennessee.
Identifiers: *Flow patterns (Groundwater), Memphis, Tennessee.

The flow pattern and its effect on chemical quality distribution of the water in the '500-foot' sand, the artesian aquifer which is the major source of supply for the Memphis area, Tennessee, are described. The recharge area is south and east of Memphis. All the discharge in the Memphis area is from pumping, and an abundant supply of water is predicted even with increased withdrawal. Continuous withdrawals at a gradually increasing rate since 1886 have lowered water levels and altered hydraulic gradients, changing the original water movement to a more or less radial pattern toward areas of withdrawal. The rate of movement calculated by a flow net analysis is about 350 ft per yr and is increasing. The water is generally a Ca-Mg-Na-bicarbonate type, soft, low in total dissolved solids, high in carbon dioxide, and somewhat corrosive. Little change in quality is predicted with increased withdrawal, or with increased recharge caused by impoundment of water over the upstream outcrop on the Wolf River. (Knapp-USGS)
W68-01130

FLOW OF GROUNDWATER IN RELATIVELY THICK LEAKY AQUIFERS,
New Mexico Institute of Mining and Technology, Socorro.
Mahdi S. Hantush.
Water Resources Res, Vol 3, No 2, pp 583-590, 1967. 8 p, 2 fig.

Descriptors: Groundwater, New Mexico, Conductivity, Groundwater movement, *Aquifer, *Leakage, *Water loss.

Solutions to several problems of flow in leaky aquifers are obtained using a differential equation that includes a leakage term in addition to the usual terms of the equation of groundwater motion. The effect of leakage on the flow is incorporated in the differential equation rather than expressed as a boundary condition, as it actually occurs in the physical system. This approximation is justified when the main aquifer is relatively thin and the conductivity of the semipervious layer relative to those of the main aquifers of the leaky system is small. (Affleck-Ariz.)
W68-01186

REFRACTION DETERMINATION OF WATER TABLE DEPTH AND ALLUVIUM THICKNESS,
University of Wyoming, Laramie.
James Otto Duguid.
Geophysics, Vol 33, No 3, pp 481-488, June 1968. 7 p, 4 fig, 2 tab, 5 ref.

Descriptors: *Water table, *Aquifers, Alluvial deposits, Seismographs, Geologic investigations, *Seismic investigations, Bedrocks, *Refraction, Drilling, Velocity, Depth recorders, Seismic waves, Groundwater geology, Ground water, Geophysics, Thickness, Seismology.
Identifiers: *Seismic refraction, *Seismic tests, *Groundwater depth, Laramie River, Wyo, Wyoming, Travel time.

An investigation was made to obtain a geologic cross section of the alluvial channel of the Laramie River in Wyoming. The cross section was needed in calculating ground-water flow in the alluvial channel and locating aggregate deposits nearby. The depth from the surface to the bedrock was determined by seismic refraction and drilling. Time-distance curves were obtained using a shallow refraction seismograph, and indicated 2 refraction interfaces. The shallower interface is the groundwater table whose depth was obtained with an accuracy of plus or minus 10%. The deeper interface is either the surface of the bedrock or the base of the weathered zone on the bedrock. If the lower interface is the surface of the bedrock, the velocity of seismic waves in weathered material will be considerably lower than if the interface is the base of the weathered zone. Determining whether the seismic wave is refracted from the surface of the bedrock or the base of the weathered zone is possible, using this criterion. (USBR)
W68-01209

NONSTEADY-STATE FLOW IN PHREATIC AQUIFERS,
Hershel Weinberger.
Water Resources Res, Vol 4, No 3, pp 569-571, June 1968. 3 p, 5 ref.

Descriptors: *Groundwater, *Hydraulics, *Porous media, *Darcy's law, *Mathematical studies, Nonuniform flow.
Identifiers: *Inertial terms in flow equations.

Analytical solutions of equations for groundwater flow that contain inertial terms are derived and compared with solutions of equations assuming Darcian flow. The differences between the calculated seepages are immeasurably small for practical values of aquifer constants. (Knapp-USGS)
W68-01227

GROUNDWATER SEEPAGE RATES,
All-Union Scientific Res Inst of Hydrogeology and Geol Eng, Moscow, USSR.
N. A. Ogil'vi, and D. I. Fedorovich.
Consultants Bur, N Y, 1966. Translated by N. H. Choksy. 33 p, 12 fig, 2 tab.

Descriptors: *Seepage, *Flow-rates, Core drilling, Osmotic pressure, Groundwater movement, Hydrodynamics.
Identifiers: *Groundwater seepage, Electrolytic method.

The phenomenon of groundwater seepage, one of the fundamental characteristics of ground flow, is examined. The most prevalent geophysical method for determining the magnitude of the rate of groundwater seepage is electrolytic (resistometric) core sampling, for which a series of equations is derived. Certain theoretical aspects of the electrolytic method are defined in detail and special attention is devoted to the computation of the hydrodynamic resistance of filters and to the role of the natural diffusion of salts. The influence of osmotic circulation processes on measurements is examined, and an analytic solution of the seepage rate problem in the presence of rising water flow in the borehole shaft is provided. Some practical pointers on field-work methods and the processing of measurement results are outlined. The actual computation of the velocity of water motion in the pipe is reported. (Llaverias-USGS)
W68-01237

GEOLOGY AND GROUND WATER RESOURCES OF THE KALISPELL VALLEY, NORTHWESTERN MONTANA,
U. S. Geological Survey, Water Resources Div.
For primary bibliographic entry see Field 04B.
For abstract, see .
W68-01265

GROUND-WATER LEVELS IN NEW MEXICO, 1966,
U. S. Geological Survey.
For primary bibliographic entry see Field 04B.
For abstract, see .
W68-01266

GROUNDWATER FLOW AND THE GEOTHERMAL REGIME OF THE FLORIDIAN PLATEAU,
U. S. Geological Survey, Water Resources Div.
F. A. Kohout.
Trans. Gulf Coast Ass of Geol Soc, Vol 17, pp 339-354, 1967. 16 p, 12 fig, 1 tab, 17 ref.

Descriptors: *Groundwater movement, *Geothermal studies, *Heat flow, *Florida, Gulf of Mexico, Aquifer characteristics, Hydrogeology, Dolomite, Diffusivity, Fresh water, Saline water, Artesian wells, Springs.
Identifiers: *Groundwater flow, *Geothermal profile, Floridian Plateau, *Oil-exploratory wells, Cyclic flow.

A hypothesis is presented that the geothermal regime of the Floridian Plateau is modified by cold sea water (40-45 deg F) in the Gulf of Mexico and the Florida Straits. Temperature surveys in oil-exploratory wells indicate an anomalous geothermal profile for the plateau. The geothermal gradient is negative (groundwater becomes colder) to a depth of 3,000 ft msl. At 3,000 ft groundwater has a temperature of about 70 deg F near the edge of the deep sea water bodies and warms to more than 108 deg toward the central axis of the Floridian Plateau. Horizontal and verticle temperature patterns suggest that cold, dense sea water flows inland through the cavernous dolormite in the deep part of the aquifer, where it becomes progressively heated by upward geothermal heat flow. Density reduction produces upward convective circulation bringing sea water into contact with fresh water recharged through sinkholes in the karst region inland. The diluted sea water then flows seaward to be discharged by upward leakage into shallow aquifers, or discharges as submarine springs on the continental shelf and slope. (Lang-USGS)
W68-01270

2G. Water in Soils

DYNAMICALLY SIMILAR MOTION OF TWO MISCIBLE CONSTITUENTS IN POROUS MEDIUMS,
U. S. Department of Agriculture, Agr Res Serv.
P. A. C. Raats, and D. R. Scatter.
Water Resources Res, Vol 4, No 3, pp 561-568, June 1968. 7 p, 2 fig, 1 tab, 14 ref.

Descriptors: *Porous media, *Groundwater, *Soil moisture, *Dispersion, Hydrodynamics, Mixing, Mathematical models.
Identifiers: *Oscillatory mean motion, *Creeping mean motion, Navier-Stokes equations.

Interest is directed toward the simultaneous motion of pairs of miscible constituents in porous mediums. Certain assumptions about the movement of the mixture relative to the solid phase, and of the two constituents relative to each other are deduced by a different method. Geometrically similar porous mediums are considered, and conditions for dynamic similarity are sought. It is found that in general the constituent pairs must have the same Schmidt number; this restriction, however, does not apply in the case of negligible inertial terms in the Navier-Stokes equations. In the special case of steady, creeping mean motion, the dispersion arising can be described macrosopically in terms of a dispersivity; it is shown that such a dispersivity must be a unique function of the microscopic Peclet number. In the case of oscillatory, mean motion, the dispersion at appropriately scaled positions and times will also depend upon the dimensionless amplitude of the displacement. (Llaverias-USGS)
W68-01031

BULK VOLUME AND HYDRAULIC CONDUCTIVITY CHANGES DURING SODIUM SATURATION TESTS,
California Univ., Berkeley.
L. J. Waldron, and G. K. Constantin.
Soil Sci Soc Amer, Proc, Vol 32, No 2, pp 175-179, March-April 1968. 5 p, 3 fig, 2 tab.

Descriptors: *Hydraulic conductivity, *Sodium chloride, California, Permeameters.
Identifiers: Bulk volume, Bimodal model, Pore-size distribution.

A study was conducted in which the concentration of permeating NaCl solutions was varied following sodium saturation resulting in pronounced changes in hydraulic conductivity and specific bulk volume in 5 of 6 fragmented California soils leached under 0.05 bar axial stress in a perameter. A mechanical explanation is given which was based on a bimodal pore model of the soil and on the way in which variation of stress from point to point within the soil affects volume changes of the swelling material and the pore size distribution. In the reclamation and irrigation of salt affected soils, the chemical composition of the water has a great effect on the hydraulic conductivity of many soils.
W68-01070

A MONTHLY CLIMATIC FACTOR FOR THE WIND EROSION EQUATION,
U. S. Dept. of Agriculture, Manhattan, Kansas. Agricultural Research Service.
N. P. Woodruff, and Dean V. Armbrust.
J soil and Water Conserv, Vol 23, No 3, pp 103-104, May-June 1968. 2 p, 2 fig, 1 tab.

Descriptors: Monthly, *Climatic data, Regional analysis, *Wind erosion, *Equations, Wind velocity, Variability, Soil moisture.
Identifiers: *Climatic factors.

For areas of the United States where wind erosion is most severe, maps were prepared with indicated lines of equal wind erosion climatic factor by month. Areas were: Great Plains, Pacific Northwest, Great Lakes and Atlantic and Gulf Coast States. Equations used to calculate annual and monthly climatic factors showed that wind velocity differences strongly influenced the climatic factor which may vary from a small value, indicating low erosion potential, to a large value, indicating high erosion potential, during the year. Applying the equations to a wind erosion problem at Midland, Texas it was found that month to month variation in the climatic factor caused month to month variation in erosion potential or residue requirements for wind erosion control even though soil, residue and roughness conditions remained constant throughout the year. Monthly climatic factors reflected short-term condition better than annual factors. Use of the monthly factors was recommended in all applications of the wind erosion equation. (Blecker-Ariz)
W68-01086

MICROMORPHOLOGICAL STUDY OF SOIL CRUSTS,
Arizona Agricultural Experiment Station, Tucson.
For primary bibliographic entry see Field 03F.
For abstract, see .
W68-01097

MODIFICATION OF THE PERMEABILITY OF LOESS BY ELECTROLYTES,
Brooklyn College, New York.
Milton J. Rosen.
Soil Sci, Vol 105, No 1, pp 51-56, Jan 1968. 6 p, 4 fig, 3 tab.

Descriptors: *Permeability, *Infiltration, *Loess, Aridity.
Identifiers: Polyvalent cations, Polyvalent anions.

An investigation using 50 cm long soil columns was conducted to determine the effect of surface chemical treatment on the infiltration rate and permeability of a loess soil taken from the grounds of the Arid Zone Research Institute in Beersheva, Israel. It was found that the intrinsic permeability and rate of infiltration of water into a loess soil, dried for at least two days at 45 to 50 deg C can be significantly increased by treatment with solutions of salt of polyvalent cations. On the other hand, treatment with solutions of polyvalent anions results in a marked decrease in permeability and rate of infiltration. In many arid regions a major problem is the relatively low permeability to water of the loess resulting in erosion and flooding. (Afleck-Ariz)
W68-01098

EFFECT OF GRAZING ON INFILTRATION IN A WESTERN WATERSHED,
Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colorado.
For primary bibliographic entry see Field 04D.
For abstract, see .
W68-01105

BOUNDARY FLOW IN LABORATORY PERMEAMETERS USED TO STIMULATE RECHARGE BY CYCLIC WATER SPREADING,
Ariz Univ and Univ Water Resources Center, Tucson.
B. K. Worcester, T. H. McIntosh, and L. G. Wilson.
Water Resources Res, Vol 4, No 3, pp 591-595, June 1968. 5 p, 5 fig, 11 ref.

Descriptors: *Hydraulic conductivity, *Groundwater recharge, *Infiltration, *Laboratory tests, Scaling.
Identifiers: *Laboratory permeameters, *Cyclic water spreading, Flood-dry cycling.

Evaluation was made with laboratory permeameters of the potential contribution of boundary flow to hydraulic conductivity under conditions of soil swelling and shrinking in cyclic flood-dry infiltration studies. Hydraulic conductivity in the boundary zone was less than that of the inner matrix for a 2-mm sand. Conversely, flow rate was greatest in

ne boundary zone for finer-textured sandy-loam oils. Divergence between the conductivity of the ner zone and the boundary zone was greatest dur- g the first flooding period. For both matrix zones, hanges in hydraulic conductivity within a flood ycle and with a number of flood cycles, although f different magnitude, tended to be similar and arallel. A laboratory permeameter design is resented to facilitate partitioning the relative con- ributions of flow in the boundary and inner zones n the hydraulic conductivity values of soils. For 3 naterials used, boundary flow along permeameter alls influenced hydraulic conductivity values in ne soil matrix near the wall. Neglecting boundary ow in critical studies of effects of cyclic treatment n hydraulic conductivity may thus introduce sig- ificant errors in the results. (Llaverias-USGS) W68-01120

ILTRATION RATES OF GROUND WATERS,
All Union Scientific Research Institute of Oil and Geology and Exploration, Moscow.
A Ye Gurevich.
nt Geol Rev, Vol 10, No 7, pp 811-816, July 1968. p, 25 ref.

Descriptors: *Darcys law, *Non-Newtonian flow, Percolation, *Clay minerals, *Groundwater movement, Flow, Groundwater, Hydraulic gradient, Permeability, Porous media.
Identifiers: *Buckingham-Reyner equation, Swart- endruber equation.

Field observations and experimental data suggest hat movement of groundwater under small gradients in rocks of low permeability is slower han that predicted by Darcy's law, and the rela- ionship of head gradient to percolation rate is non- inear. Clay particles bond thin layers of water in which it is not a perfectly Newtonian liquid, but a viscous-plastic substance with some shear strength. If the depth of bonding approximates the pore diameter, Darcy's law will not be valid. It is sug- gested that in deep basins with rocks of low permeability the rate of groundwater and oil move- ment is on the order of .0001 cm per yr through the rock, and that more rapid movement would have to be caused by tectonic movements. The possibility of multiple solution cycles in the generation of highly mineralized deep basin waters is also sug- gested. (Knapp-USGS) W68-01136

EFFECT OF TALLOW ALCOHOL ADDED TO SOIL ON THE TENSION, FLOW, AND EVAPORATION OF SOIL WATER,
Procter and Gamble Co., Cincinnati, Ohio.
Don G. Kolp, Frank P. Krause, and Willy Lange.
Water Resources Res, Vol 2, No 2, pp 213-222, 1966. 10 p, 7 fig, 1 tab, 18 ref.

Descriptors: *Alcohols, *Moisture tension, Soil-water movement, *Evaporation, Soil microorgan- isms, Porosity, Moisture content, Capillary conduc- tivity, Infiltration, Soil moisture, Retardants, Films, Air-water interfaces, Pore pressure, Earth-water in- terfaces, *Flow rates.
Identifiers: Fatty alcohols, Soil pores, *Tallow al- cohol.

The effects of tallow alcohol (TA), which is a mix- ture of fatty alcohols, on the tension, flow, and evaporation of soil water as well as on plants and soil microorganisms were studied. The soil was a fine sandy loam. All the effects of TA on the soil- water system were traced to the formation of com- pressed TA films on the air-water interfaces in the soil pores. If TA had access to all soil pores, the soil-water tension would be lowered by one-half. An additional tension-lowering occurred in large pores, presumably because of a soil-water contact angle increase. The films lowered the tension gradient between soil layers of unequal water con- tent and reduced the flow rate of water between them. TA had no effect on the capillary conductivi- ty of the soil. The effectiveness of TA depended upon its concentration and form of dispersion in the soil. (Blecker-Ariz.) W68-01173

GRAIN SIZE DISTRIBUTION AND ITS EFFECT ON THE PERMEABILITY OF UNCON- SOLIDATED SANDS,
Texas Univ., Austin; Brown and Root Construction Co., Houston, Texas.
Frank D. Masch, and Kleber J. Denny.
Water Resources Res, Vol 4, No 2, pp 665-677, 1966. 13 p, 11 fig, 2 tab.

Descriptors: *Particle size, *Sands, *Permeability, Hydraulic properties, Dispersion, Groundwater, Aquifers, *Distribution patterns, *Parametric hydrology, Sampling, Statistical methods, Hydrau- lic conductivity, Equations, Porous media.

One of the most important quantitative measures of the hydraulic transmission of groundwater through an aquifer is permeability. The objectives of the study were to conduct permeability tests using un- consolidated mediums with known grain size dis- tributions and to relate the resulting permeability values to the various distribution parameters, and second to determine whether a method could be devised to predict the permeability values of ran- dom field samples from a knowledge of certain of their statistical grain size distribution parameters. The method of graphical statistics to describe a grain size distribution included measures for the average diameter, dispersion, skewness and peakedness of the particles within a given distribu- tion. Permeability values increased with increasing size values of the particle diameter. For a given value of the particle diameter, permeability values increased with decreasing values of the inclusive standard deviation. A correlation system based on the particle diameter and the inclusive standard deviation values could be used to approximate the permeability coefficients for field samples. (Blecker-Ariz.) W68-01175

2H. Lakes

CHEMICAL AND BIOLOGICAL STUDIES ON SOME SALINE LAKES OF SOUTH-EAST AUS- TRALIA,
Monash Univ., Clayton, Victoria.
I. A. E. Bayly, and W. D. Williams.
Aust J Mar Freshwat Res, Vol 17, No 2, pp 177- 228, 1966. 52 p, 14 fig, 15 tab, 123 ref.

Descriptors: *Saline lakes, Dissolved solids, Salini- ty, Animals.
Identifiers: Australia.

The chemical and biological aspects of 18 saline lakes were studied in south-eastern South Aus- tralia. In all the lakes sodium was the dominant ca- tion and chloride the dominant anion. Fluctuations in concentration of total dissolved solids were both absolutely and relatively great in all lakes sampled at three month intervals with the exception of three lakes. The stability of the exceptions was due to their greater volume or depth. The biological data were divided into two categories; macro and micro fauna. They were discussed with particular reference to affinity, tolerance to high salinities, level of endemicity and uniqueness. It was con- cluded that the fauna was different in many respects from that of similar habitats outside Aus- tralia. (Affleck-Ariz) W68-01082

LIMNOLOGICAL EFFECTS OF ORGANIC EX- TRACTS OF LITTER IN A SOUTHWESTERN IMPOUNDMENT,
Arizona Univ., Tucson, Arizona Cooperative Fishery Unit.
William J. McConnell.
Limnology and Oceanography, Vol 13, No 2, pp 343-349, April 1968. 7 p, 1 fig, 4 tab, 16 ref.

Descriptors: Limnology, Carbohydrates, Phenols, Arizona, Aquatic microorganisms, Fish harvest, Oxygen requirements.
Identifiers: *Litter, Unleached, Organic extracts, Filter-feeding organisms, Biomass production, Trophic efficiency.

Watershed litter in semiarid southeastern Arizona is relatively unleached, and the accumulation of a year or more is occasionally delivered to lakes within the first few days of the summer rainy season. During the summer of 1959 more than 750 g/m super 2 of oak litter was deposited on the bot- tom of Pena Blanca Lake, but was less than 50 g/m super 2 in 1965 and 1966. About 329 kg cal/m super 2 were delivered to the lake in oak litter ex- tracts of which 26% were probably from car- bohydrates, 54% from phenolic compounds, and 20% from unidentified compounds. The growth rate of Xenopus larvae was significantly increased by the addition of newly fallen oak leaves to the en- vironment. Xenopus biomas gains for 0.67 and 1.0 g of leaves were 149 and 150 percent of the control gain. Based on the experimentally determined rela- tionship of production of filter-feeders and scum feeders to litter import a carnivore biomass produc- tion based on litter extract is estimated to be 0.4 g/m super 2. (Affleck-Ariz) W68-01093

2I. Water in Plants

WATER BALANCE IN DESERT ARTHROPODS,
California Univ., Riverside.
E. B. Edney.
Science, Vol 156, No 3778, pp 1059-1066, May 1967. 8 p, 10 fig, 2 tab, 56 ref.

Descriptors: *Water shortage, *Desert, Xerophilic animals.
Identifiers: *Arthropods.

The structural and functional mechanisms of arthropods are considered which are important in relation to the water shortage and high tempera- tures found in the desert. Factors which enabled arthropods to survive in desert regions were discussed. Some of these were size, water loss through integuments, water loss through spiracles, tolerance of water loss, temperature tolerance, ox- idation water, and absorption of water vapor. It was concluded that despite their small size, arthropods may be highly adapted for life in xeric conditions. W68-01069

EDAPHIC RANGE AND COHABITATION OF SOME MALLEE EUCALYPTS IN SOUTH- EASTERN AUSTRALIA,
Melbourne Univ., Parkville, Victoria; Soil Conser- vation Authority of Victoria, Kew, Victoria.
R. F. Parsons, and J. N. Rowan.
Aust J Bot, Vol 16, pp 109-116, 1968. 8 p, 1 fig, 3 tab.

Descriptors: *Trees, Brush, *Rainfall, *Soil tex- ture, Arid climates, Topography.
Identifiers: Eucalyptus species.

Species of Eucalyptus showing the mallee habit are widespread across southern Australia, especially between the 8 and 20 in. mean annual rainfall isohyets. Seven mallee eucalypts which occurred throughout the entire area were selected for study. The most significant single soil feature affecting plant growth was surface texture. Laboratory and field observations showed that the fertility of the soils increased with increasing clay content. In the climate of the study area, water supply to plants decreased with increasing clay content. Species with extensive ranges in areas wetter than 18-19 in. mean annual rainfall were E. incrassata and E. foecunda. Species whose upper limit for mean an- nual rainfall was approximately 18-19 in. included E. oleosa, E. oleosa var. angustifolia, E. gracilis, E. calycogona and E. dumosa. The distribution of E. incrassata, E. oleosa and E. oleosa var. angustifolia was studied. The species of E. calycogona and E. gracilis were confined to a relatively distinct suite of soils. The species of E. incrassata and E. foecun- da occurred in all topographic positions. (Blecker-Ariz)

W68-01078

PERUVIAN DESERT MICE: WATER INDEPENDENCE, COMPETITION, AND BREEDING CYCLE NEAR THE EQUATOR,
California Univ., Berkeley.
Carl B. Koford.
Science, Vol 160, No 3827, pp 552-553, 1968. 2 p, 1 fig.

Descriptors: *Rodents, Aestivation, Dehydration.
Identifiers: *Sechura Desert, Water independence.

The ecology of the rodent, Phyllotis gerbillus, was studied in the arid region of the Sechura Desert of Northwestern Peru. The native mouse was able to survive on dry seed without drinking water while losing about 8 percent of their body weight. House mice were also able to tolerate dehydration, and in some areas may displace the native mouse. One Phyllotis gerbillus displayed the ability to reduce water loss, especially pulmonary evaporation, by aestivation at temperatures of about 25 deg C. (Affleck-Ariz)
W68-01081

MOISTURE STRESS IN A VEGETATIONAL CONTINUUM IN THE SONORAN DESERT,
Ohio State Univ., Columbus.
For primary bibliographic entry see Field 03F.
For abstract, see .
W68-01103

MOISTURE AND TEMPERATURE REQUIREMENTS FOR GERMINATION OF THREE ANNUAL SPECIES OF MEDICAGO,
CSIRO, Canberra, ACT, Division of Plant Industry.
W. D. Andrew.
Australian J of Exp Agr and Animal Husb, Vol 5, No 19, pp 450-452, Nov 1965. 3 p, 3 fig, 1 tab.

Descriptors: *Germination.
Identifiers: Moisture requirements, *Medicago, Australia.

Germination requirements for moisture and temperature were determined for Medicago minima, M.truncatula and M.polymorpha in a semi-arid region of southern Australia where ability to germinate within a few days after rain determines success or failure of a species. Germination studies of moisture included placing seeds in water and weighing to determine weight increments due to imbibition, determination of water absorption once germination had commenced and the influence of varying atmospheres of osmotic pressure on germination. It was found in all three species water uptake was most rapid in the first two hours. In five hours M.minima was almost fully imbibed while M.polymorpha and M.truncatula took longer. Increasing the tension had a depressive effect on germination of M.polymorpha while M.minima was stimulated at 0 to 3 atmospheres. Temperature requirements were studied using constants of 15 deg, 20 deg, 25 deg, and 30 deg. Temperature requirements for germination were M.minima is greater than M.truncatula is greater than M.polymorpha. (Affleck-Ariz)
W68-01107

XEROPHYTIC STRUCTURES IN THE ROOTS OF DESERT SHRUBS,
Hebrew Univ., Jerusalem, Israel.
Chen Ginzburg.
Ann of Botany, N S, Vol 30, No 119, pp 403-418, July 1966. 16 p, 4 fig, 2 tab, 50 ref.

Descriptors: *Shrubs, *Root systems, Xerophytes, Desert plants, Arid climates, Habitats, Saline soils, Sampling, Halophytes, Cytological studies, Plant physiology, *Dicots, *Vascular tissues, *Environmental effects, Soil water movements.
Identifiers: Negev Desert, Israel, Root cap.

The study attempted to ascertain to what extent dry and salty habitats influence root structure of their natural vegetation. Structures of 30 perennial dicotyledonous species, which grow in five different habitats in the Negev were compared. Samples from the seedling roots were taken 2-5 cm above the uppermost cell layer of the root cap. The graph of measurements of the width of the casparian strips in the different species indicated in gradient existed from the salty habitats down to the loess plains and the river-beds, which were the less-saline habitats. A number of hydrohalophytes which had a fairly deep root system had a relatively small area of the primary tracheae in transverse section of the root. Reduction of the cortex in xerophytes increased the diffusion gradient between the soil solution and the central cylinder, thus enhancing water movement. The ratio between the quantitative development of the cortex and the central cylinder in xerophytes was contrary to that in mesophytes. (Blecker-Ariz.)
W68-01170

GEOGRAPHIC DISTRIBUTION AND FACTORS AFFECTING THE DISTRIBUTION OF SALT DESERT SHRUBS IN THE UNITED STATES,
USGS, Water Resources Division, Denver, Colorado.
F. A. Branson, R. F. Miller, and I. S. McQueen.
J of Range Management, Vol 20, pp 287-296, 1967. 10 p, 7 fig, 5 tab, 27 ref.

Descriptors: *Salt tolerance, *Soil moisture, Saline soils, Soil properties, Vegetation establishment, Plant groupings, *Moisture stress, Shrubs, Desert plants, Distribution patterns, *Systematics, *Halophytes, Osmotic pressure, Soil-water-plant relationships, Distribution patterns.
Identifiers: *Salt desert shrubs.

The origin of salt desert shrub vegetation was given. Four published classifications of intermountain shrub vegetation and a new classification based on maximum salt tolerances and water relationships were presented. The distribution of salt desert shrub communities together with the geographic distribution of salt desert shrub species and some causative factors for the presence of salt desert shrub communities were given. Soil-moisture relationships were the primary cause of the different plant communities. Quantities of soil salts appeared to be important as a cause of community differences. (Blecker-Ariz.)
W68-01176

2J. Erosion and Sedimentation

RATES OF EROSION AND SOIL FORMATION (IN THE HUMID AND ARID SUBTROPICS OF THE USSR),
Ryazan Agricultural Institute, Ryazan, USSR.
A. M. Burykin.
Soviet Soil Sci, Vol 6, pp 688-700, Jan 1966. 13 p, 7 tab, 40 ref.

Descriptors: *Erosion, *Soil formation, Humid climates, Arid climates, Climatology, *Precipitation, *Temperature, *Fertility cultivation, Soil moisture, Humus, Nitrates, Soil properties, Land use.
Identifiers: USSR.

The natural processes of soil formation and accumulation of elements that promote soil productivity are quite slow. The main factors influencing the rates of erosion and soil formation are climate (amount of precipitation and temperature), relief and agricultural activity. Soil erodibility in the arid subtropics is 12 times or more greater than in the humid subtropics. Fertility may decrease rapidly as a result of continuous cultivation, especially in arid hot regions where heating of the soil is much more vigorous than in humid regions because of inadequate moisture and high air temperatures. Since a water deficiency is a negative factor in soil formation in hot arid regions, any change in soil moisture that may be caused by the relief, influences the species composition and density of the vegetation and consequently the rate of soil formation. The rate of artificial restoration of fertility of eroded soils is 10 times that of natural restoration. (Blecker-Ariz)
W68-01169

SAND DISPERSION IN A LABORATORY FLUME,
Colorado State Univ., Department of Civil Engineering, Fort Collins.
Tsung Yang.
PhD Thesis.

Descriptors: *Flumes, *Sediment transport, *Dispersion, *Computer programs, *Stochastic processes, Sediment discharge, Sedimentology, Mass transfer, Digital computers, Mathematical studies, Synthetic hydrology, Sediment-water interfaces, Boundary processes.
Identifiers: *Sediment dispersion, Aris moment equations, Mass-conservation equations.

A general 1-dimensional stochastic model describes and predicts the longitudinal dispersion of sand or pollutants that move with bed load under conditions of steady uniform flow. The parameters used can be obtained either from longitudinal dispersion and transport data, or from bed configuration data, or both. Statistical analysis of ripple bed configurations indicates that the distribution of bed elevation closely follows a normal distribution and may be ergodic. Aris moment equations are used to solve the problem of sand dispersion of suspended sand near the bed. Aris moment equations are modified forms of mass-conservation equations for transport, deposition, and re-entrainment of particles in suspension. When appropriate initial and boundary conditions are used, solutions of the Aris moment equations and the 1-dimensional stochastic model analysis agree excellently. In flume experiments, radioactive sand particles were used as tracers for ripple- and dune-flow conditions. Both longitudinal displacement and variance of distribution increased linearly with time, as in the stochastic model. Experimental longitudinal dispersion curves also fit the stochastic model fairly well. Fortran programs for the Aris moment equations and the stochastic model are included. (Knapp-USGS)
W68-01247

VARIATIONS OF THE HYDRAULIC ROUGHNESS OF ALLUVIAL CHANNELS,
U. S. Geological Survey, Tucson, Ariz.
For primary bibliographic entry see Field 08B.
For abstract, see .
W68-01273

2K. Chemical Processes

DETERMINATION OF MOLYBDENUM IN FRESH WATERS - A COMPARISON OF METHODS,
U. S. Geological Survey.
Marvin J. Fishman, and Edward C. Mallory, Jr.
J Water Pollut Contr Federation, Part 2, pp R67-R71, Feb 1968. 5 p, 1 tab, 8 ref.

Descriptors: *Chemical analysis, *Inorganic compounds, *Aqueous solutions, *Trace elements, Colorimetry, Flame photometry, Photometry, Spectrometers, Spectroscopy, Water chemistry.
Identifiers: *Molybdenum analysis, Atomic absorption, Dithiol methods, Thiocyanate methods.

Molybdenum was analyzed using 4 different methods on 14 fresh water samples ranging from 90-800 mg/l in total dissolved solids and 0.001-3.9 mg/l in molybdenum. The thiocyanate, spectrographic, dithiol-atomic absorption, and dithiol-colorimetric methods were used. In 21 of 14 samples, molybdenum values found by spectrography were lower than values by other methods. The results from the thiocyanate and dithiol methods agree more closely. Detailed laboratory procedures are given for all methods. Under ideal conditions as little as 0.001 mg/l of molybdenum may be de-

tected. The dithiol method is preferred if only molybdenum is to be determined, and the spectrographic method is preferred for multiple-constituent determinations. The results obtained are presented in a table. (Knapp-USGS)
W68-01046

RESEARCH ON ELECTRORECLAMATION OF SALINE-ALKALI SOILS,
Bureau of Reclamation, Denver, Earth Laboratory Branch.
Harold J. Gibbs.
Amer Soc of Agr Eng, Trans, Vol 9, No 2, pp 164-169, 1966. 6 p, 12 fig, 2 tab.

Descriptors: *Saline soils, *Land reclamation, *Alkali soils, Leaching, Electrical studies, *Direct current, Calcium carbonate, Drainage, Laboratory tests, Soil chemical properties.
Identifiers: *Electroreclamation.

The process of direct-current electrical treatment was considered for reclaiming alkali and saline-alkali soils at Deaver, Wyoming. The treatments were to leach the soil with water alone and to use water plus electricity. Each test consisted of a boxlike block of soil bounded so that electricity was confined to moving in a direct path from one end of the box to the other. The chemical trends shown may be considered favorable toward reclaiming alkali soil. Electrical treatment appears to promote calcium carbonate, which is generally unavailable for exchangeable sodium, encourage replacement with calcium, and increase movement of soluble salts, particularly sodium salts, toward the cathode. Electrical treatment was found to increase the reaction of carbonates, thus releasing calcium for exchange. Although electricity encouraged solution movement and promoted desirable reactions, leaching and drainage were considered major factors in carrying the undesirable materials away. In the laboratory tests, electrical treatment appeared to cause a desirable environment that makes leaching and drainage more effective when compared to similar tests without electricity. (Blecker-Ariz)
W68-01108

SELECTIVE ION ELECTRODE SYSTEM FOR FLUORIDE ANALYSIS,
Foxboro Co., Foxboro, Mass.
For primary bibliographic entry see Field 07B.
For abstract, see .
W68-01116

USE OF MERCUROUS CHLORIDE TO RECOVER TRACE AMOUNTS OF GOLD FROM WATERS,
U S Geological Survey, Denver.
E. A. Jenne, T. T. Chao, and L. M. Heppting.
Econ Geol, Vol 63, No 3, pp 420-421, May 1968. 2 p, 9 ref.

Descriptors: *Chemical analysis, *Gold, *Water chemistry, *Trace elements, Geochemistry, Inorganic compounds, Filtration, Membranes, Solvent extractions, Flame photometry, Spectroscopy.
Identifiers: *Atomic absorption analysis, Geochemical prospecting.

Coprecipitation and slurry technique for recovery of gold in natural waters for trace determinations have been found to be unreliable, but use of a very thin mercurous chloride layer on a membrane filter results in quantitative recovery of gold. The presence of other metals does not interfere. More than 95% of gold in the range of 0.001 to 0.05 ppb was consistently recovered in tests of the method. The minimum reagent necessary was 1 g for 2 in. filters and 0.3 g for 1 in. filters. Mercurous chloride particles sometimes passed 0.45 micron filters, so 0.2 micron filters were used. The solutions were acidified with HCl to minimize sorption of gold on containers. Recovery was independent of pH between 0.1 and 1.2. Flow rates up to 100 ml/min were used but lower rates yield more reproducible results. For atomic absorption analysis, the reagent and membrane may be dissolved in HBr (10 ml) +NaBr (0.25 g), and gold extracted with MIBK or ethyl ether. In water draining Colorado goldfields gold concentration is generally less than 0.05 ppb and 20 liters of water are required for analysis. (Knapp-USGS)
W68-01124

ADSORPTION CATALYZED CHEMICAL HYDROLYSIS OF ATRAZINE,
Wisconsin Univ. Madison.
For primary bibliographic entry see Field 03F.
For abstract, see .
W68-01246

A FLEXIBLE COMPUTER PROGRAM FOR EVALUATION OF EMISSION SPECTROMETRIC DATA,
Woods Hole Oceanographic Inst.
For primary bibliographic entry see Field 07C.
For abstract, see .
W68-01252

PHYSICAL-CHEMICAL PROPERTIES OF NATURALLY OCCURRING POLYELECTROLYTES-- (PART) 1, SODIUM HUMATE,
U S Geological Survey, Denver.
Robert L. Wershaw, and Patricia J. Burcar.
Proc of 3d Annu Water Resources Conf, San Francisco, Calif, Nov 8-10, 1967, pp 351-364, 1967. 14 p, 6 fig, 2 tab, 36 ref.

Descriptors: *Chemical properties, *Soils chemistry, *Humic acids, Water chemistry, Molecular structure, Biochemistry, Analytical techniques, Artificial recharge.
Identifiers: *Polyectrolytes.

Almost all soils contain natural polyelectrolytes, of which humic acid is the most important that interact with pollutants and must be understood for water-spreading recharge projects. The organic matter in soil affects toxicity of herbicides and leaching rates of pesticides. Humic acid is the akalisoluble, acid-insoluble, amorphous, brown to black fraction of soil. It is not known whether humic acid is a single substance, a mixture of related compounds, or an unrelated mixture. Infrared spectra suggest that humic acid is primarily aromatic. Polarography shows that 6-8% of humic acid consists of carbonyl groups. Electron paramagnetic resonance studies show free radicals. Under alkaline conditions electron spin increases, suggesting a quinhydrone or hydroquinone behavior pattern. Temperature dependent studies suggest two types of radical species. Several different molecular-weight fractions have been determined. Although these data suggest a wide variety of humic acids, molecular sieve chromatographic studies indicate a group of several different size fractions, and diversity of molecular weights might be representative only of different size-fraction proportions. X-ray scattering data suggest several sizes of particles or a single particle type with electron-density stratification. (Knapp-USGS)
W68-01253

CHEMICAL GEOHYDROLOGY,
U. S. Geological Survey, Water Resources Div., Menlo Park, Calif.
John D. Hem.
Proc of Nat Symp on Ground-Water Hydrol, Amer Water Resources Ass, pp 107-112, Nov 6-8, 1967. 6 p, 2 fig, 4 ref.

Descriptors: *Geochemistry, *Groundwater, *Water chemistry, *Hydrogeology, Soil chemistry, Physiochemical properties.
Identifiers: *Chemical geohydrology, Equilibrium chemistry.

Chemical geohydrology, or the study of the chemistry of water-rock systems, is reviewed. Waters may be classified by naming dominant anions and cations. By using graphs and pattern diagrams, general similarities and differences among waters may be emphasized. Recent work stresses application of the principles of equilibrium chemistry to water systems. Rock composition, temperature, concentration, circulation patterns, and biological processes, all of which are related to climate and hydrology, influence concentrations of solutes and ionic species derived from rocks. Equilibrium reasoning must be used cautiously in rock-water systems. Some reactions are to slow in flowing water to reach equilibrium. Some solution products immediately react irreversibly to form other minerals. More detailed studies of field conditions than are usually made in groundwater investigations are necessary to provide sufficient data for chemical geohydrologic work. (Knapp-USGS)
W68-01263

2L. Estuaries

SEDIMENTATION IN ONSLOW BAY (IN GUIDEBOOK FOR FIELD EXCURSIONS, GEOLOGICAL SOCIETY OF AMERICA, SOUTHEASTERN SECTION),
Geological Society of America, Southeastern Section, Durham, N. C.
William J. Cleary, and Orrin H. Pilkey.
Southeastern Geol Spec Publ No 1, pp 1-17, Apr 1968. 17 p, 17 fig, 19 ref.

Descriptors: *Sedimentation rates, *Bays, *Currents (Water), Estuaries, Continental shelf, Sea water, North Carolina, Shoals, Coastal plains, Sands, Particle size, Fresh water, Salinity.
Identifiers: Piedmont sediments, *Heavy minerals, Florida current, Gulf Stream, Relict fauna.

Sediment sources and rate and pattern of deposition in bays on the North Carolina Continental shelf are discussed. Slow rate of sedimentation in Onslow Bay is attributed to lack of large river discharge into the bay and to limited exchange of sediment from adjacent Long and Raleigh Bays. Residual sediments in Onslow Bay contain an unstable heavy minerals suite similar to sediments of Piedmont rivers. Since Coastal Plain rivers that drain only Tertiary terranes empty into Onslow Bay, it is evident that much of the bay sediment is transported by inter-embayment currents from Long and Raleigh Bays, which receive runoff from Piedmont streams that carry waters with heavy minerals. Main sources of water in the embayment are the warm and very saline Florida current, the less saline Carolinian Coastal waters, and, periodically, currents from the Virginia Coastal areas. Axis of the Gulf Stream is 20 mi seaward from the 100 fathom contour; the meandering sharply-defined edge of the Florida current often comes as close inshore as Lookout shoals. Bottom movement is onshore at a rate of 0.5 mi per day. (Lang-USGS)
W68-01262

SUSPENDED SEDIMENT OF THE NORTHERN CHESAPEAKE BAY,
Johns Hopkins Univ., Chesapeake Bay Institute, Baltimore, Maryland.
J. R. Schubel.
Johns Hopkins Univ. Chesapeake Bay Inst Tech. Rep 35, 264 p, Mar 1968. 88 fig, 16 tab, 56 ref, 4 append.

Descriptors: *Suspended load, *Sedimentation rates, *Bays, *Estuaries, Particle size, Sediment load, Runoff, Sediment discharge, Provenance, Clays, Silts, Organic matter, Beach erosion.
Identifiers: *Chesapeake Bay, *Suspended sediment, Susquehanna River, Suspended organic matter.

Suspended sediment of the northern Chesapeake Bay was studied by determining the concentrations of total suspended solids and of combustible organic matter. Suspended sediment concentration was always greater than 5 mg/liter with maximum values of 110 mg/liter in Mar during peak river flow. Combustible organic matter concentration

was highest in spring and summer, averaging nearly 5 mg/liter, and lowest in winter at 3 mg/liter. Suspended sediment exceeded 140 mg/liter at peak flow at mouth of the Susquehanna, the principal source of fluvial sediment. Except for times of peak discharge, concentration of sediment in the bay was higher than in the river. In 80% of samples the mean projected diameter of particles was between 1.4 and 2.0 microns. Mean Stokes diameter was from 2.3 to 12.2 microns. Illite was the most common mineral. The Susquehanna discharged 0.6 million metric tons of sediment between 1 April 1966 and 31 March 1967, 70% of it at peak discharge in late February and early March. About 0.1 million tons originated from coastal erosion. A net sedimentation rate of 2-3 mm per year is indicated. The pattern of sedimentation is net deposition, with fluvial domination at times of high runoff, and resedimentation and resuspension the rest of the year. (Knapp-USGS)
W68-01268

03. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

NEW CONCEPTS FOR DESALTING BRACKISH WATER,
Bechtel Corp., Vernon, Calif.
William A. Homer.
J Amer Water Works Assoc, Vol 60, No 8, pp 869-881, Aug 1968. 13 p, 9 fig, 3 tab, 15 ref.

Descriptors: *Desalination plants, *Flash distillation, *Nuclear energy, Electrodialysis, Vapor compression distillation, Ion exchange, Membrane processes, Reverse osmosis, Solar distillation.
Identifiers: *Sulphate-bisulphate cycle, Clearator brine, Polyelectrolytes.

Summary data are provided in this conference paper dealing with various concepts of desalting brackish water. Tabular data are presented on a dual-purpose power and desalting plant capable of producing 1,800,000 kw of electricity using nuclear energy and 150 mgd of desalted sea water using heat from nuclear reactors. A combination plant provides low-cost energy to the distillation process (energy requirement data tabulated). A flow diagram of a desalting plant process illustrates the multi-stage flash distillation method of desalination. A cross section of a large multi-stage flash plant shows the flashing brine, condensing tubes, and product water trough. It is noted that the multi-stage flash distillation continues to be the most widely used of the distillation processes. A simplified diagram of the multiple-effect distillation process is provided; it uses the principle of boiling rather than flashing. Summary data are also provided on: solar distillation, electrodialysis, ion-exchange, new desalting process, freezing processes, freezing-compression, direct contact freezing and the hydrate formation process. (Laverias-USGS)
W68-01126

WATER RESEARCH AND DEVELOPMENT.

42 USCA Sec 1951 - 1958g, pp 5-16, 1964. 12 p (66 Stat 328).

Descriptors: *Desalination, Federal Government, *Legislation, Saline water, Administrative agencies, Administration, *Desalination plants, Desalination processes, Water quality, *Pilot plants, Water resources development, Consumptive use.
Identifiers: Secretary of the Interior.

Congressional policy is to provide for low-cost, large scale production of water suitable for beneficial consumptive uses from saline and brackish water. The Secretary of the Interior is directed to conduct, encourage and promote research into methods, processes and plant designs. Recommendations are to be made for the construction of demonstration plants. Research into by-products of the conversion process, and the costs of such process is directed. Broad powers are granted to the Secretary. Cooperation with the Department of Defense and other Federal agencies is provided for, and the results of all studies resulting from Government expenditure are to be made available to the public. The Secretary is authorized to sell water and by-products resulting from the operations and is directed to make reports to Congress. An appropriation is authorized. The Secretary is directed to construct five demonstration plants, each using a different process, and in a different geographic area. Various other requirments and authorizations are made in connection with these plants. (R. F. Williams-Fla)
W68-01323

3B. Water Yield Improvement

A STATISTICAL INVESTIGATION OF PERSISTENCE IN THE ISRAELI ARTIFICIAL RAINFALL STIMULATION EXPERIMENT,
Hebrew Univ., Jerusalem, Israel.
K. R. Gabriel, Y. Avichai, and Raya Steinberg.
J of Applied Meteor, Vol 6, No 2, pp 323-325, April 1967. 3 p, 6 tab.

Descriptors: *Rainfall, *Cloud seeding, *Dry seasons, Summer, Winter, Weather modification, Persistence, Statistical methods, Analytical techniques.
Identifiers: Israel.

The question of whether AgI (silver iodide) can somehow persist in a target region and produce delayed seeding effects weeks and months after release was discussed. A winter season experiment with a randomized cross-over design using four areas was used. The apparent effect of seeding was strongest in the first short season of 1961. It is a priori unlikely that persistence could carry over to the dry summer between one seeding season and the next. There was no evidence of within-season persistence. Since the standard errors of the means are so large, they could have obscured the slight day-to-day persistence if it existed. None of the tests described had shown any statistical evidence of persistence, of either long or short duration, of effects of AgI seeding of clouds. (Blecker-Ariz)
W68-01094

AVAILABILITY OF GROUND WATER IN THE HICKMAN QUADRANGLE, KENTUCKY-MISSOURI-TENNESSEE,
U S Geological Survey.
T. W. Lambert.
U S Geol Surv Hydrol Invest Atlas HA-181, 1 sheet, 1968. 1 map, 2 tab, 4 ref.

Descriptors: *Groundwater, *Hydrologic data, *Aquifers, *Water quality, *Water levels, Water wells, Hydrogeology, Water table, Water sources, Water yield, Kentucky, Chemical analysis.
Identifiers: Jackson Purchase, Kentucky, Hickman quadrangle.

Abundant groundwater supplies are available in the Hickman area, in the Mississippi valley, west-central Fulton County, Kentucky; at present little is being used. The most important aquifers are the Quaternary alluvium and Eocene sands. A water-availability map shows where water may be obtained and the quality to be expected. The alluvium may be over 200 ft thick, but the deepest well penetrates only 165 ft. Depth to water ranges from 0 to 25 ft below land surface near the Mississippi River at low stage. The Eocene sands are about 1,300 ft thick and dip generally southward. Hickman's city well field pumped about 285,000 gpd in 1966. Potential yield of wells in the Eocene aquifer may be as much as 2,000 pgm. Wells in the deeper part of the sand may flow. Water in the alluvium is very hard and contains 292-536 ppm total solids. Iron and manganese are present in objectionable quantities. Water in the Eocene sand is excellent and improves with depth. Total solids range from 100-300 ppm. A geologic section describes the lithology and hydrology of rocks from Creatceous to Recent. A map, scaled 1:24,000, shows availability of water, location of wells, and quality of water. (Knapp-USGS)
W68-01122

INTERIM APPRAISAL OF OKLAHOMA BASINS PROJECT, OKLAHOMA: WATER--THE KEY TO OKLAHOMA'S FUTURE.
U. S. Bureau of Reclamation, Denver, Colo.
For primary bibliographic entry see Field 06B.
For abstract, see .
W68-01131

MINERALS AND WATER, BUTLER COUNTY, ALABAMA.
Geological Survey of Alabama, University, Ala.

Geol Surv of Ala Inform Ser 36, 37 p, 1967. 5 tab, 12 ref.

Descriptors: *Water resources, *Groundwater, *Surface waters, *Water quality, *Aquifers, Alabama, Water wells, Data collections, Water levels, Water yield, Discharge (Water), Streamflow, Peak discharge, Low flow.
Identifiers: *Butler County, Alabama, *Well data, Annual streamflow.

The water resources of Butler County, Alabama are described as part of a report on the geology, mineral resources, and water resources of the county. Groundwater evaluation is based on records of 188 wells and 1 spring. The principal aquifers are sand beds in the Eutaw, Ripley, and Nanafalia Formations, and limestone beds in the Clayton Formation, of upper Cretaceous to Cenozic age. A map and cross section indicate maximum depths necessary for wells that will produce 0.5 mgd; depths needed for domestic wells are also mapped. Water from the Ripley Formation is generally soft, and water from the other aquifers ranges from soft to hard. Chloride, iron, and hardness contents are shown on maps. Average runoff is 19 in. or 0.9 mgd per sq mi. Many of the streams in the western part of the county are intermittent. In the northwest the water is moderately hard during flood flow and hard during low flow. In the east the water is soft during flood flow and moderately hard during low flow. In other parts of the county surface water is soft. All stream water has less than 15 ppm content chlorides. (Knapp-USGS)
W68-01137

GROUND-WATER RESOURCES OF THE APPALACHIAN REGION,
U. S. Geological Survey.
Granville G. Wyrick.
U S Geol Surv Hydrol Invest Atlas HA-295, 4 sheet, 1968. 8 map, text, 74 ref.

Descriptors: *Groundwater, *Water wells, *Hydrologic data, *Water yield, *Appalachian Mountain Region, Aquifers, Hydrogeology, Water sources, Cost analysis, Unit costs, Evaluation, Geology, Discharge (Water).
Identifiers: *Hydrologic atlas, Groundwater development cost.

Data on the occurrence and availability of groundwater and the cost of developing groundwater supplies for the Appalachian region are compiled from published and unpublished reports. Specific site information is not given. The atlas consists of 4 sheets of 2 maps each on a scale of about 50 mi per in. The maps show location of the region, geology, geologic features favoring groundwater occurrence, groundwater discharge to streams, maximum yield of wells, costs of well fields yielding 1 mgd, cost of groundwater, and optimum groundwater development at indicated costs. A thorough explanation accompanies each map. (Knapp-USGS)

W68-01140

WATER RESOURCES OF THE SALISBURY AREA, MARYLAND,
Maryland Geological Survey, Baltimore.
Durward H. Boggess, and Sumner G. Heidel.
Maryland Geol Surv Rep of Invest No 3, 69 p, 1968. 28 fig, 12 tab, 10 ref, 1 append.

Descriptors: *Water resources, *Groundwater, *Surface waters, *Water quality, *Water yield, Aquifers, Hydrogeology, Flow characteristics, Duration curves, Data collections, Logging (Recording), Maryland.
Identifiers: Salisbury, Maryland.

Large quantities of good-quality groundwater and surface water are available for development in the Salisbury area, Maryland. The surface-water runoff is about 18 in. per yr and is largely undeveloped. The Pleistocene Salisbury Formation is the principal aquifer and supplies most of the 8 mgd used in the area. Its estimated safe yield is 45 mgd. Conjunctive development of surface and groundwater supplies will yield about 1 mgd per sq mi, or about 90 mgd from the area. Large unused supplies of groundwater are available from the Naylor Mill Buried alluvial channel in which the Salisbury Formation is about 230 ft thick. Yields of 3,000-4,000 gpm may be obtained from wells in the thicker parts of the formation. Smaller quantities of water are available from the Miocene Manokin and Nanticoke artesian aquifers, which are used only where the Pleistocene sediments are thin or contain poor water. The deeper water, however, is not as good as most of the water from Pleistocene sediments. (K-napp-USGS)
W68-01141

POTENTIAL APPLICATIONS OF NUCLEAR EXPLOSIVES IN DEVELOPMENT AND MANAGEMENT OF WATER RESOURCES--PRELIMINARY CANVASS OF THE GROUND-WATER ENVIRONMENT,
U. S. Geological Survey.
For primary bibliographic entry see Field 08H.
For abstract, see .
W68-01142

SELECTED HYDROLOGIC DATA, SAN PITCH RIVER DRAINAGE BASIN, UTAH,
U. S. Geological Survey.
G. B. Robinson, Jr.
Utah Div of Water Rights, Basic-Data Release No 14, 44 p, 1968. 1 fig, 1 plate, 8 tab, 11 ref.

Descriptors: *Data collections, *Hydrologic data, *Groundwater, *Surface waters, Water wells, Logging (Recording), Discharge (Water), Water quality, Springs, Water levels, Utah.
Identifiers: San Pitch River basin, Utah.

Data collected in a groundwater resources investigation of the San Pitch River drainage basin during 1964-67 are presented. Data collected since 1930 are appended. The data include records of selected wells, records of selected springs, water levels in observation wells, drillers' logs of wells, interpretations of geophysical and drillers' logs, stream discharges, chemical analyses of waters from wells, springs, and streams. Specific conductance of water from streams at measured or estimated discharge rates is tabulated. A map, scaled 4 mi per in., shows location of wells, springs, and surface water sampling sites. (Knapp-USGS)
W68-01146

XEROPHYTIC STRUCTURES IN THE ROOTS OF DESERT SHRUBS,
Hebrew Univ., Jerusalem, Israel.
For primary bibliographic entry see Field 02I.
For abstract, see .
W68-01170

SUPPLY.
Arizona Interstate Stream Commission, Phoenix.

In Report, Ariz Water Res, Chapter I, pp 1-31, Oct 1967. 32 p, 7 plate, 13 tab.

Descriptors: *Water supply, Water resources development, Groundwater, Rainfall disposition, Recharge, Overdraft, Watersheds (Basins), Interstate commissions, *Hydrologic cycle, Evaporation, Surface waters, Water quality, River systems, Precipitation (Atmospheric), *Runoff, *Reservoirs, *Lakes, Floods, Hydrogeology.

The Arizona Interstate Stream Commission conducted a study of Arizona's water resources. The problem of supply was one aspect dealt with. Of a total area of 114,000 sq miles only 334 sq miles were found to be water surface. Annual precipitation had a state wide variation from 3 inches in desert areas to 30 inches in some mountain areas with the major portion occurring in July, August and September. All groundwater was derived either directly or indirectly from rainfall or some form of precipitation. Only 1% of the total annual precipitation contributed to recharge and natural groundwater recharge did not equal groundwater withdrawal by pumps. More than 95% or approximately 75 million acre feet was lost through evapotranspiration. Drainage was by three interstate river systems: the Colorado, Gila and Little Colorado Rivers. The study area was divided into four parts on the basis of aforementioned river systems and the fourth comprised Sulpher Springs Basin and other Mexican drainage areas. Total water supply was estimated at nearly 10 million acre feet and included the overdraft of groundwater which was estimated to be 3 million acre-feet annually. (Affleck-Ariz.)
W68-01181

PLANNING FOR WATER RESOURCE DEVELOPMENT.
Arizona Interstate Stream Commission, Phoenix.
For primary bibliographic entry see Field 06B.
For abstract, see .
W68-01185

ELECTRONIC ANALOG MODELING AS AN AID IN WATER RESOURCE INVESTIGATIONS,
Soil Conservation Service, Salt Lake City, Utah.
Erlend B. Warnick.
Pap No 68-233, Annu Meeting, Amer Soc Agr Eng, Logan, Utah, June 1968. 16 p, 7 fig, 1 tab, 2 ref.

Descriptors: *Electric analogs, *Analogs, Electronic equipment, Crops, Electronics, Simulation, Water resources, Water supplies, Watersheds, Hydrology, Hydrologic data, *River basins, Drainage basins, Runoff, Land resources, Irrigation, Irrigation efficiencies, *Streamflow, Underground water storage, Water management, Aquifers, Water utilization.
Identifiers: Sevier River Basin, Utah, *Hydrologic models, Root zone, Inflow, *Analog instruments, Water use, Effect.

An electronic analog model capable of simulating condition s affecting water supply and use was used to study water and land resources in the Sevier River Basin, Utah. The study was made by the Agricultural Research Service, Soil Conservation Service, and the Utah Water Research Laboratory at Logan. Monthly data input for the model included: (1) total irrigation diversions to cropland area, (2) irrigation water pumped from wells, (3) precipitation, (4) cropland potential consumptive use, (5) wetland potential consumptive use, (6) tributary runoff, (7) river inflow into model area, (8) reservoir releases, and (9) river and groundwater flow from model area. Investigators obtained an understanding of relation and timing of the various hydrologic processes in a shorter time and with less expenditure than they could have using conventional methods. The probable effects on the flow of the river and on the ground-water basins caused by potential soil and water conservation programs were determined before these programs were put into effect. (USBR)
W68-01232

FLOODS IN THE MAYAGUEZ AREA OF PUERTIO RICO,
U. S. Geological Survey.
I. J. Hickenlooper.
U. S. Geol Surv Hydrol Invest Atlas HA-288, 1 sheet, 1968. 4 fig, 1 map.

Descriptors: *Floods, *Stage-discharge relations, *Puerto Rico, Hydrologic data.
Identifiers: *Mayaguez, *Flood frequency, *Flood profiles, Water surface contours, Atlas.

In relation to hydrologic investigation of the Mayaguez Area of Puerto Rico, an atlas (scale 1:20,000) is presented to illustrate 1933 and 1963 flooded agricultural lands. The greatest known flood on Rio Yaguez occurred on Mar 3, 1933, when 24-hr precipitation of 17.40 in. was recorded at Mayaguez. Flood stage- and discharge-frequency relations at Calle Post are shown graphically. Flood profiles of the maximum elevations of the water surface for specific floods along arbitrarily chosen base lines show on the map. Water surface contours are drawn on the basis of floodmarks and are good indicators of water-surface elevations in most inundated areas. Maximum depth of flooding can be estimated at any point in the inundated areas for the flood of July 30, 1963, by subtracting the ground elevation from the water-surface elevation (i.e, water-surface contours on the map). (Laverias-USGS)
W68-01272

WATER SUPPLY: SUGGESTED FEDERAL REGULATION,
Lois G. Forer.
Harv L Rev, Vol 75, No 2, pp 332-349, Dec 1961. 18 p, 74 ref.

Descriptors: *Administrative decisions, *Federal government, Water supply, Beneficial use, Reasonable use, Interstate compacts, *Federal power act, *Hydrologic cycle, River basin development, Watershed management.
Identifiers: Constitutional law, Water Conservation Act.

Private action and existing mechanisms for public action, such as interstate compacts, are inadequate to cope with the increasing water shortage. Local water law, be it riparian or appropriation, fails in that it provides no adequate forum for weighing public interest in the development of a region, comparative costs, and alternative uses. Nor does it provide for a consideration of ground-water resources as an integral part of surface waters being allocated. High costs, inadequacy of limiting decision making boundaries, and conflicting interests in development projects without an agency to resolve them are discussed as problems requiring an exercise of federal power. Jurisdiction of federal government over rivers for water supply purposes could be coextensive with jurisdiction for power or economic development. Citing the gap between technological feasibility and legal structure as the critical obstacle to government regulation, the author proposes the creation of a federal administrative agency with planning and regulatory power over water resources modeled after the Federal Power Commission. (MacMillan-Fla)
W68-01317

WATER SUPPLY ACT OF 1958.
For primary bibliographic entry see Field 06E.
For abstract, see .
W68-01342

MISSISSIPPI WATER-USE LAWS AND ADMINISTRATION,
Institute of Law and Government, School of Law, Georgia Univ., Athens.

For primary bibliographic entry see Field 06E.
For abstract, see .
W68-01351

EASTERN LAWS CONCERNING MINIMUM STREAM FLOWS AND IMPOUNDMENTS,
Institute of Law and Government, College of Law, U of Georgia, Athens.
For primary bibliographic entry see Field 06E.
For abstract, see .
W68-01357

PROGRESS REPORT.

Board of Water Commissioners, State of Mississippi, Jackson, pp 1-51, Jan 1960. 51 p, 12 fig, 7 tab.

Descriptors: *Mississippi, Legislation, *Water resources development, Administrative agencies, Hydrologic data, On-site data collection, Legal aspects, Prior appropriation.

This is a report by Mississippi's first Board of Water Commissioners near the end of their four-year appointments. Activities of the Board include the issuance of permits under the Water Rights Law, information and educational programs for the public, and the inventory of surface and ground water resources. Studies of land and water resources have been made, but much more information is required. It is recommended that a water quality program be established, and that additional funds be provided for the administration of a more comprehensive water resources program. The report also contains the Mississippi Water Rights Law.
W68-01367

WATER RIGHTS LAW IN KENTUCKY WATER SUPPLY OF KENTUCKY.
Kentucky Legislative Research Commission.

Water Rights Law in Kentucky, pp 21-54, Feb 1956. 33 p, 5 plate, 7 map, 9 ref.

Descriptors: *Kentucky, *Water supply, *Geomorphology, *Watersheds (Basins), Hydrologic cycle, Climatic data, Rainfall intensity, Air temperature, Evapotranspiration, Regions, Topography, Surface waters, Low flow, Natural flow, Droughts, Groundwater, Alluvium, Water law.

The hydrologic cycle is explained with the use of a plate, including the factors which affect availability of water. Kentucky has a continental climate, with an average annual precipitation over 45 inches. Average and extreme temperatures are discussed, as is evapotranspiration. Kentucky is divided into six major physiographic regions. Each of these regions is divided into smaller sections and discussed with the aid of maps. The discussion focuses on topography. A similar analysis with a map centers on Kentucky's principal drainage basins. 8 river basins are covered. The majority of water problems in southeastern states are related to distribution. A plate shows the fluctuations of average stream flows in Kentucky. A map shows the locations of stream gaging stations and the minimum recorded flow for each station. Droughts are a major factor affecting water supply in Kentucky. Because of geological formations, good supplies of groundwater are not available in Kentucky. A map is used to illustrate the problem. In Kentucky, an owner of land has an absolute right to all percolating water beneath his land. Withdrawal of percolating waters cannot be wasteful or malicious, however, without liability to other owners.
W68-01387

RETARDATION OF EVAPORATION FROM OPEN WATER STORAGES,
Irrigation Research Station Poondi, Madras, India.
S. Shanmugam.
Irrig and Power (India), Vol 25, No 1, pp 61-67, Jan 1968. 7 p, 3 fig, 1 tab.

Descriptors: *Evaporation control, *Alcohols, *Monomolecular films, Instrumentation.
Identifiers: India, Poondi Irrigation Research Station, Buderi Lake.

Reservoir evaporation loss control procedures were field tested in an area in India with an annual evaporation of 5-7 ft. Straight-chain alcohols may be spread to cover water with a monomolecular film. Cetyl or stearyl alcohol or combinations of both were particularly adaptable for this purpose. Evaporation loss was reduced 20-25%. Alcohol was spread 3 ways: in turpentine solution, in emulsified form, and in powder form. The solution method was found to be the most practical, considering costs of materials and their transportation to remote areas. The amounts needed ranged from 0.1 to 0.8 pound per acre depending on wind conditions and method of application. (Knapp-USGS)
W68-02256

3C. Use of Water of Impaired Quality

FRESH AND SALINE GROUND-WATER ZONES IN THE PUNJAB REGION, WEST PAKISTAN,
U S Geological Survey.
Wolfgang V. Swarzenski.
U S Geol Surv Water-Supply Pap 1608-I, 1968. 24 p, 2 fig, 3 plate, 14 ref.

Descriptors: *Saturated soils, *Saline soils, *Saline water, *Saline water systems, *Groundwater, Fresh water, Water pollution sources, Alluvium.
Identifiers: Punjab, Pakistan.

An extensive program of test drilling and water sampling undertaken to evaluate hydrologic problems related to waterlogging and soil salinity has furnished data for the delineation of fresh and saline groundwater zones in the alluvial aquifers of the Punjab region. Fresh groundwater with less than 500 ppm total dissolved solids content is found in wide belts parallel to major rivers and in other recharge areas. The fresh groundwater zone of northeastern Rechna Doab is the most areally extensive in the region; it is 1,700 feet or more in thickness. Fresh groundwater is found as deep as 1,500 ft near the Indus River. Saline groundwater occurs downgradient from recharge, particularly in the central part of interfluvial areas; generally, salinity increases away from recharge areas, but there is no sharply defined salt-groundwater body. The groundwater composition grades from Ca-Mg bicarbonate type near recharge to Na-Chloride-bicarbonate-sulfate types. The most highly mineralized waters in Punjab are Na-chloride types, and in the Dera Ismail Khan district Na-sulfate waters prevail. Distribution pattern of saline zones can be explained best by evaporation from the water table and concentration of minerals dissolved from the alluvial aquifer. (Knapp-USGS)
W68-01039

QUALITY OF GROUNDWATER FOR IRRIGATION IN AHOR DEVELOPMENT BLOCK, JALORE DISTRICT, WESTERN RAJASTHAN,
Central Arid Zone Research Institute, Jodhpur, India.
R. K. Saksena, M. L. Sharma, and H. R. Jodha.
Annals of Arid Zone, Vol 5, No 2, pp 204-218, 1966. 15 p, 2 fig, 6 tab, 23 ref.

Descriptors: *Groundwater, *Water quality, *Irrigation water, Water utilization, Salts, Sampling, Exploitation, Alkalinity.
Identifiers: Rajasthan Desert, India.

The groundwater of the Ahor development block, Jalore District, western Rajasthan was sampled, analyzed and classified according to known classifications and their applicability on the basis of utilization. The area was divided into four zones depending upon the safe yield from wells in the region. It was found 59.6% of the groundwater was being utilized mostly for irrigation. 63.5% of the total water samples had negative salt index and the remainder - positive salt index. Of these 34.6 and 25.0% respectively were utilized for irrigation. Water used for irrigation also had a salt index between 7.19 and 59.34 with the total salt concentration up to 6.82 me/l and were utilized for irrigation. Classifications based on Puri's Salt Index or Eatons' Residual Alkalinity agreed with actual utilization of water in this region. (Affleck-Ariz)
W68-01091

UNUSUAL MONOMIXIS IN TWO SALINE ARIZONA PONDS,
Arizona State Univ., Tempe, Zoology Dept.
Gerald A. Cole, Melbourne C. Whiteside, and Robert J. Brown.
Limnology and Oceanography, Vol 12, No 7, pp 587-591, 1967. 8 p, 4 fig, 4 tab.

Descriptors: *Saline, Runoff, Seepage, Evaporation, Chlorophyta, Phosphate.
Identifiers: *Monomixis, Chloro-carbonates.

A study of the unusual temperature cycle and other limnological features of two small saline ponds was conducted in Arizona. The waters are carbonate-chloride and chloro-carbonate with pHs which vary between 8.4 and 10.0 during the year. The concentration of orthophosphate, ranging up to 500 mg/liter, was considered to be very high. Isothermy, dichothermy, mesothermy, and poikilothermy occur during the year. The calculated heat budgets were 863 cal/cm super 2 for Green Pond, 1,138 for Red Pond. The saline pools stratify chemically during the winter and circulate in the summer. The circulation is caused by the increased salinity of the vapor waters due to evaporation while stability is brought about by dilution of the surface water by runoff and seepage. The green alga, Ctenocladus circinnatus, was found in both ponds. (Affleck-Ariz)
W68-01095

RESEARCH ON ELECTRORECLAMATION OF SALINE-ALKALI SOILS,
Bureau of Reclamation, Denver, Earth Laboratory Branch.
For primary bibliographic entry see Field 02K.
For abstract, see .
W68-01108

INDUS RIVER BASIN STUDIES.
Harvard Univ., Cambridge, Mass.

Final Rep Sci Adv Secretary Interior, USDI, Washington, D. C., 1965. 308 p, 67 fig, 28 tab, 38 ref, 10 append.

Descriptors: *Salinity, *Linear programming, Approximation method, Digital computers, Constraints, Economic efficiency, Groundwater mining, *Irrigation efficiency, Irrigation systems, *Irrigation wells, River basins, *Surface irrigation, Surface-groundwater relationships, Water management (Applied).
Identifiers: Non-linear programming, Method of steepest ascent, Indus River Basin.

An extensive report on the Indus River Basin study employing Linear programming techniques to perform suboptimizations on a larger non-linear problem. The problem was to determine optimum allocations of surface and ground water supplies between two areas, of high and low salinity, in the Indus River Basin. Several simulation models of the basin, with their hydraulic interactions under various pumping schemes, were introduced as a foundation for the optimization model. Salinity, sodium, mining-export, and areal loading constraints were defined. A modification on the method of steepest ascent was used as an optimization technique. The non-linear objective function was linearized in the vicinity of a feasible solution and the optimal solution was found by standard linear programming techniques. Results of the Indus study were tabled and discussed.
W68-01148

RECLAMATION OF ANCIENT AGRICULTURAL SOILS IN WAHIDI, SOUTH ARABIA,
Empire Cotton Growing Corp., London; Dept., of Agriculture, Federation of South Arabia.
A. B. Hearn, D. A. Rijks, and D. E. Wilcox.
Exp Agr, Vol 2, No 4, pp 279-296, October 1966. 8 p, 1 fig, 3 tab.

Descriptors: *Land reclamation, Soils, Cotton, *Plant growth, *Irrigation practices, Yield, Timing, Irrigation efficiency, Soil-water-plant relationships, Silts, Crop response.

The rehabilitation and utilization of ancient silty soils has been attempted by growing cotton as the main cash crop under irrigation from wells. Growth in the early years was poor and crop failures were frequent. A heavier pre-planting irrigation was proposed to overcome the physical impedance to drainage. Data indicated that heavy pre-planting irrigation was necessary to avoid poor growth. The extra water applied was available for growth later in the season, permitting subsequent irrigation to be reduced without loss of yield. The timing and quantity of the first irrigation after planting was important. (Blecker-Ariz.)
W68-01177

DISSOLVED-MINERAL INFLOW TO GREAT SALT LAKE AND CHEMICAL CHARACTERISTICS OF THE SALT LAKE BRINE: SUMMARY FOR WATER YEARS 1960, 1961, AND 1964,
U S Geological Survey.
For primary bibliographic entry see Field 02E.
For abstract, see .
W68-01249

3D. Conservation in Domestic and Municipal Use

INTEGRATING MANAGEMENT OF GROUND AND IMPORTED WATER IN LOS ANGELES COUNTY,
California Agricultural Experiment Station, Berkeley.
Robert L. Leonard.
Calif Agr, Vol 19, No 9, pp 11-13, Sept 1965. 3 p.

Descriptors: *Water management (Applied), Water supply, Water rights, Water policy, *Groundwater, *Surface waters, Water distribution (Applied), Water resources development.

Integration of management of imported water supplies and groundwater has become essential in Los Angeles County due to increased water demand. Two approaches contributing to needed integration of management have been adjudication of individual pumping rights and replenishment of overdrawn basins with imported water purchased by a local public district. Used in conjunction with imported surface water supplies, groundwater basins were thought to be useful in smoothing fluctuating water needs. A variety of programs were proposed to finance replenishment. (Affleck-Ariz)
W68-01193

THE HIERARCHY OF WATER QUALITY,
North Carolina Univ., Department of Environmental Sciences and Engineering, Chapel Hill.
Daniel A. Okun.
Environ Sci and Technol, Vol 2, No 9, pp 672-675, Sept 1968. 4 p, 5 ref.

Descriptors: *Water supply, *Sanitary engineering, *Public utilities, *Water distribution (Applied), *Distribution systems.
Identifiers: *Dual water distribution systems.

The use of dual water supply systems is proposed as a solution to the problem of high municipal water demands. Only about 10% of municipal water is used for human consumption and can be supplied in a separate smaller system. The rest does not need to be potable if it is supplied separate from drinking water; it may be virally or bacterially contaminated to some extent without causing severe problems. Each water system could be designed for optimum economy; materials and pressures suitable for the intended use need not be the same for both systems. Reclaimed waste water would be cheaper in a dual system because it would require less treatment. Protection from cross connections is the most important safety measure that would need to be undertaken. (Knapp-USGS)
W68-01257

THE EFFECTS OF VARYING LAND AND WATER USE ON STREAMFLOW REGIMEN,
Wyoming Univ., Laramie.
For primary bibliographic entry see Field 04C.
For abstract, see .
W68-01261

DECISIONS RELATING TO DISTRIBUTION OF PUBLIC WATER SUPPLIES,
John Marshall Law School, Chicago.
Frank A. Marston.
John Marshall L Q, Vol 6, No 4, pp 539-554, Jun 1941. 16 p, 58 ref.

Descriptors: Judicial decisions, Legal aspects, Local governments, Water contracts, Conduit, *Water injury, *Cities, *Pipelines, Water supply, Water works, Negative pressure, Municipal water, *Damages.

It is well established rule that the operation of public works such as water works by a municipal corporation or a private corporation is a proprietary function, to which liability will attach for negligence. The negligence of a corporation, or its employee or agent must be proved by the party claiming damage. Damage may be caused by leakage from distribution system (usually breaks in pipes), poor water quality, structural defects in the system, lack of pressure or water, substandard or careless construction methods, negligent operation or maintenance of the system, and hazardous conditions on the users premises. Each of these areas is elaborated upon, with cases given as examples. Emphasis is placed upon the fact that not only damage, but also the negligence of the water authority, must be proved.
W68-01374

WATER RIGHTS LAW IN KENTUCKY
WATER USE IN KENTUCKY.
Kentucky Legislative Research Commission.

Water Rights Law in Kentucky, pp 55-64, Feb 1956. 9 p, 3 tab, 11 ref.

Descriptors: *Kentucky, *Water utilization, *Water users, Domestic water, Stock water, Municipal water, Statistics, Water shortage, Volume, Industrial water, Water cooling, Boiler feed water, Environmental sanitation, Irrigation water, Economic efficiency, Costs.

The major uses of water in Kentucky are for domestic purposes, municipal supply, industry, irrigation, hydroelectric power, and recreation. Uses may be consumptive or non-consumptive. Domestic use has the highest priority. Statistics on the volume of water used domestically, in the home and by livestock, are presented. At the time of this study, over 46 percent of Kentucky citizens were served by municipal supplies. Statistics on per capita use, municipal water shortages, and municipal pumpage are included. Water is a resource in industry. Water use in industry is in four categories: cooling, processing, boiler feed, and sanitary and service purposes. Each is discussed along with volume requirements and a table. Irrigation is becoming more important. The economics of irrigation is considered. Because of the high cost of irrigation systems, the need should be clearly established before purchase. A table provides estimates on annual water use in 1955 by categories, i.e., municipal, industrial, domestic and irrigation.
W68-01388

3F. Conservation in Agriculture

RELATIVE TURGIDITY TECHNIQUE FOR SCHEDULING COTTON (GOSSYPIUM BIRSUTUM) IRRIGATION,
U. S. Dept. of Agriculture, Weslaco, Tex., Agricultural Research Service.
L. N. Namken.
Agronomy J, Vol 57, No 1, pp 38-41, Jan-Feb 1965. 4 p, 5 fig, 3 tab.

Descriptors: *Irrigation, *Cotton, Texas.
Identifiers: *Turgidity.

Experiments were conducted in Weslaco, Texas to determine whether cotton irrigations could be adequately scheduled according to variations in the relative turgidity of the plant leaves and to study what effect plant moisture stress, during the various stages of plant growth might have on the growth and yield of cotton. Cotton was irrigated when the relative turgidity of the plant leaves sampled between 2:30 and 3:00 PM reached the 70 to 72%, 64 to 66%, and 60 to 62% ranges, respectively. At approximately 72% relative turgidity cotton plants exhibited visible wilt symptoms, but they were able to endure short periods of severe plant moisture stress without significant yield reductions. Long periods of moderate to severe plant moisture stress during the bloom stage of plant growth caused significant yield reductions.
W68-01066

RAFTS: NEW WAY TO CONTROL EVAPORATION,
Arizona Univ., Tucson. Water Resources Research Center.
C. Brent Cluff.
Crops and Soils Magazine, Vol 20, No 2, pp 7-9, 1967. 3 p, 3 fig.

Descriptors: *Evaporation control, Monomolecular films, Water tanks, Arizona, Reservoirs, Costs.
Identifiers: *Rafts.

Loss of water from small ponds is a serious problem in arid climates. Research conducted to reduce evaporation from water tanks and reservoirs in dry climates with the use of several types of rafts and monolayers was reported. The costs and advantages of polyethylene, wooden frames, styrofoam, aluminum foil bonded to polyethylene, and concrete rafts were discussed. In addition several methods are described for reducing wind shearing stress on the rafts. Results of a 4-year study on the use of monolayers for controlling evaporation on small ponds were summarized. It was found that the use of monolayers became cheaper as the size of the reservoir increased.
W68-01067

TIME OF FERTILIZER APPLICATION ON DESERT GRASSLANDS,
Arizona Univ., Tucson.
J. L. Stroehlein, P. R. Ogden, and Billy Bahe.
J of Range Management, Vol 21, No 2, pp 86-89, 1968. 4 p, 3 tab.

Descriptors: *Fertilizers, *Soil moisture, Forage grasses, Arizona.

A study was conducted to determine the proper time to fertilize semi-arid grasslands in Arizona in relation to summer rainfall patterns with respect to forage production and quality. The fertilizers used were 16-16-8 at a rate of 75 lbs N/acre and 30-10-0 at a rate of 50 lbs N/acre for 1965 and 1966, respectively. Fertilization of desert grasslands after the start of the summer rainy season gave the best results in three of four sites studied. Application of fertilizer after the first rains prevents fertilizer losses during dry seasons and assures maximum response from grasses because it is just prior to the time of the greatest demand for nutrients.
W68-01068

INFLUENCES OF PLANT MOISTURE STRESS, SOLAR RADIATION, AND AIR TEMPERATURE ON COTTON LEAF TEMPERATURE,
U. S. Dept. of Agriculture, Weslaco, Tex. Agricultural Research Service.
C. L. Wiegand, and L. N. Namken.
Agronomy J, Vol 58, No 6, pp 582-586, Nov-Dec 1966. 5 p, 3 fig, 3 tab, 22 ref.

Descriptors: *Moisture stress, Solar radiation, *Cotton, Texas, Transpiration.
Identifiers: *Leaf temperature.

Leaf temperatures vary as environmental conditions and the availability of moisture for transpiration vary. This study was conducted in Weslaco, Texas, to investigate the effect of variations in plant moisture stress on the temperature of cotton leaves and on the temperature difference between the leaves and air. Results showed that variations in plant moisture stress significantly alter leaf temperature and leaf minus air temperature. However, variations in insolation must be carefully monitored under intermittent cloud conditions to account for their influences on plant leaf temperature.
W68-01071

EFFECT OF SOIL SALINITY ON WATER POTENTIALS AND TRANSPIRATION IN PEPPER (CAPSICUM FRUTESCENS),
U. S. Dept. of Agriculture, Riverside, Calif. Agricultural Research Service.
C. F. Ehlig, W. R. Gardner, and M. Clark.
Agronomy J, Vol 60, No 3, pp 249-253, May-June 1968. 5 p, 12 fig.

Descriptors: *Saline soils, Soil moisture, Transpiration.
Identifiers: *Water potential, Pepper.

A study of the relationship between the components of water potential in pepper plant to those in the soil as a function of time as the plant extracted water from a salinated soil was conducted at the U.S. Salinity Laboratory, Riverside, California. The relation of transpiration rate to soil water content and water potential was also investigated and compared with nonsaline cases. The difference between the leaf water potential and the soil water potential was the same for both treatments. The relative transpiration rate was reduced at a much higher soil water content for the saline than for the nonsaline case.
W68-01072

SPECIES TRIALS IN THE SEMI-ARID SOUTHWEST OF NEW SOUTH WALES PART I--GRASSES AND LEGUMES,
R. M. Jones, and W. A. Muirhead.
J of Soil Conservation Serv of N S W, Vol 22, No 2, pp 102-111, April 1966. 16 p, 3 fig, 30 ref.

Descriptors: *Grasses, *Legumes, *Vegetation regrowth, *Rainfall.
Identifiers: Barrell medic, Harbinger medic.

The article summarized results from preliminary testing of introduced and native species that would give greater stability to the vegetative cover and increase pasture production. Trials were in localities with an average annual rainfall of 9-14 inches. A description of the soils in the area was given. Species were considered under five headings: annual winter legumes, annual winter grasses, perennial winter grasses, perennial summer grasses and summer legumes. Of the annual legumes, barrel medic, both standard and 173 strains, and harbinger medic showed the most promise, the latter species appeared especially suited for light soils. Summer perennial grasses had generally shown slightly more promise than winter perennial grasses.
W68-01074

SPECIES TRIALS IN THE SEMI-ARID SOUTHWEST OF NEW SOUTH WALES PART II--NATIVE SHRUB TRIALS IN THE HAY DISTRICT,
W. A. Muirhead, and R. M. Jones.
J of the Soil Conservation Serv of N S W, Vol 22, No 3, pp 138-146, July 1966. 9 p, 6 fig, 1 tab.

Descriptors: *Shrubs, *Arid climates, *Clays, *Saline soils, Infiltration, Sodium.
Identifiers: Saltbush.

After the drought years ending in the 1940's there were many scalds (claypans) in the arid Hay district (9-14 inches of annual rainfall) of southwest New South Wales. The soils were generally clays or clay loams of high salinity, extremely low infiltration, high exchangeable sodium and a marked instability to wetting, resulting in a characteristic sealed and slaked surface. The sowing into a plowed scald treatment consisted of two trials: complete plowing and saltbush trials and the sowing into reclaimed scald. The seven complete plowing trials were complete failures as far as scald reclamation was concerned. Under all sowing conditions on scald and reclaimed scald, perennial saltbush has been the outstanding species, and on areas where all the sown specied died, it gave the best persistence. The saltbushes' positive attributes were relatively reliable establishment, vigorous growth, persistence both in ungrazed and grazed conditions, spread by seed and ease with which seeds could be collected. (Blecker-Ariz)
W68-01075

RAINFALL COLLECTION FOR DOMESTIC WATER SUPPLIES,
Arizona Univ., Tucson.
W. G. Matlock, and R. J. Shaw.
Progressive Agr in Ariz, Vol 18, No 4, pp 10-11, July-August 1966. 2 p, 3 fig.

Descriptors: *Water harvesting, *Rainfall, Water supply, Arid climates, *Asphalt, *Plastics.

The feasibility of collecting rainfall for domestic and cattle water supply has been studied since 1958 in the arid Catalina Mountain foothills near Tucson, Arizona. The study also tested the duration and maintenance requirements of two surfacing materials. Average collection efficiency for the water-catching plastic was about 75%, with efficiencies as high as 90% for larger rains. The entire 8-mil black poly-vinyl plastic sheet deteriorated and had to be replaced after 27 months. The second surface material consisted of building paper placed between 2 coats of asphalt. The surface which is still in good condition was covered with a single layer of pea gravel to protect against wind damage and sunlight. Maximum collection efficiency of 60 to 70% was obtained for rains of about an inch. (Blecker-Ariz)
W68-01079

LANDFORMING FOR LEACHING OF SALINE SOILS IN A NONIRRIGATED AREA,
Agricultural Research Service, Bushland, Texas.
Leon Lyles and R. R. Allen.
J soil and Water Conserv, Vol 21, No 2, pp 57-60, March-April 1966. 4 p, 7 fig, 2 tab.

Descriptors: Leaching, *Saline soils, *Land forming, Sampling, Soil profiles, Water table, Crop response, Rainfall disposition.
Identifiers: Rio Grande Valley.

A study was conducted on a selected nonirrigated soil profile in the lower Rio Grande Valley of Texas. The saline areas occur as 'islands' or salt spots randomly scattered among nonsaline soils. The study was based on the hypotheses that the salt load in these 'islands' could be reduced in the upper profile by eliminating or offsetting the differences between saline and nonsaline areas. To determine the effect of land leveling alone, soil samples were analyzed semiannually from a transect across a 10-acre level field and compared to samples taken in a similar transect across an adjoining 10-acre nonleveled field. Land leveling alone and land leveling combined with diking caused a net salt removal in the 0-3 foot zone. Rainfall was not sufficient to remove and maintain soluble salts at a low level. Lowering the soil surface of the saline 'islands' in order to retain rainfall and collect runoff from surrounding leveled nonsaline areas effectively reduced salt loads in the 6-foot profile. The success of the surface-lowering method, however, depended upon rainfall and water table conditions.
W68-01087

GROUND WATER IN ECONOMIC DEVELOPMENT,
Utah State Univ., College of Engineering, Logan.
Dean F. Peterson.
Groundwater, Vol 6, No 3, pp 33-41, May-June 1968. 9 p, 5 fig, 3 tab.

Descriptors: *Groundwater mining, *Economic impact, *Water resources development, Wells, Salinity, Saturated soils, Water utilization, Irrigation practices, Hydrologic budget.
Identifiers: West Pakistan, Israel.

Development of ground water supplies in Israel and West Pakistan has resulted in new economic opportunities. Over half of Israel's water is supplied by ground water. This has made it possible to manage for both quality and quantity and use surface supplies and reclaimed sewage as firm rather than marginal sources. All possible natural sources of water supply will be utilized by 1975. Israel's next step will then be desalination of seawater. Development of surface supplies in the nearly level Indus Plain of West Pakistan has resulted in the threat of water logging and salinity to some 25 million acres of irrigated land, even though supplies were less than half adequate for good productivity. Ground water development was initiated by the government and 3,500 tube wells of about 3 cubic feet per second were drilled. Private enterprise installed another 30,000 wells each having one third the capacity of the government wells. Reclamation of the waterlogged and saline lands was rapid and successful. (Blecker-Ariz)
W68-01090

WATER IN WEST PAKISTAN,
Syracuse University, Syracuse, Maxwell School of Citizenship and Public Affairs.
For primary bibliographic entry see Field 06E.
For abstract, see .
W68-01096

MICROMORPHOLOGICAL STUDY OF SOIL CRUSTS,
Arizona Agricultural Experiment Station, Tucson.
D. D. Evans, and S. W. Buol.
Soil Sci Soc Amer, Proc, Vol 32, No 1, pp 19-22, 1968. 4 p, 6 fig.

Descriptors: *Penetration, Infiltration, Arizona, Compaction.
Identifiers: *Soil crusts.

Desert soil crusts were studied in Arizona by preparing and examining thin sections taken normal to the soil surface. Photomicrographs of thin sections were presented which illustrated differences encountered among different soils and among different management practices of the same soil. The crusts are common features of soil surfaces in arid and semiarid regions. Water applied to crusted soil, whether by irrigation or rainfall, will usually penetrate the soil very slowly, making irrigation difficult. Seedling emergence and the interchange of oxygen and carbon dioxide also were hampered by the soil crusts. (Affleck-Ariz)
W68-01097

A PRELIMINARY STUDY ON THE EFFECT OF ARTIFICIALLY CREATED LAYERS IN SANDY SOILS ON YIELD OF ALFALFA,
Cairo Univ.; National Research Center; El-Azhar Univ.

Abdalla Z. El Abedeine, Mohamed Radwan, and Fathy M. A. Maklad.
J Soil Sci, UAR, Vol 7, No 1, pp 45-49, 1967. 5 p, 1 tab.

Descriptors: *Alfalfa, *Crop production, Crop response, Sands, Soil moisture, Asphalt, Economic feasibility.
Identifiers: *Sandy soils, United Arab Republic, Soil layers, Plots.

Six treatments using various combinations of farm manure, sprayed asphalt, canvas, parchment paper, and plastic were tested to study the increase of alfalfa yields on sandy soils as a result of employing an artificially created deep layer of asphalt and plastic. The asphalt layer was made by spraying melted asphalt at the bottom of a 60 centimeter furrow. All the treatments which received manure yielded at least twice as much as the control. Treatments which received manure plus the impervious layer yielded significantly more than the treatment which received manure only. A layer made of asphalt sprayed over a canvas carpet gave the best results. Since the differences in yield between the canvas, parchment paper and plastic were not signigicant, the practicality of their use may depend upon the considerations such as cost of material, resistance to decomposition and the cost of application. (Blecker-Ariz)
W68-01099

PREHARVEST WATER STRESS FOR VALLEY SUGAR BEETS,
California Univ., Davis.
G. V. Ferry, F. J. Hills, and R. S. Loomis.
Calif Age, Vol 19, No 6, pp 13-14, June 1965. 2 p.

Descriptors: *Sugar beets, Irrigation, San Joaquin Valley, Fertilizers.
Identifiers: *Water stress.

It previously was assumed sugar beets which have been subject to water stress will produce less sugar per acre than plants irrigated to within a few days of harvest. To test this assumption a sugar beet crop in the San Joaquin Valley was irrigated for the last time 30, 20, and 10 days prior to harvest. Nitrogen rates of 80, 160, 240, and 320 lbs/acre were utilized to test the effect of water stress under different levels of nitrogen fertility. It was found response of water stress was independent of nitrogen fertilization. The sucrose concentration of roots was 1.2 percentage points higher for severely wilted plants. The increase was essentially linear and increased 0.06 percentage point for each additional day of stress. Fresh weight of roots decreased 0.16 ton per acre with each day of stress. The loss, however, did not result in a net loss of income. (Blecker-Ariz)
W68-01101

MOISTURE STRESS IN A VEGETATIONAL CONTINUUM IN THE SONORAN DESERT,
Ohio State Univ., Columbus.
Lionel G. Klikoff.
Amer Midland Natur, Vol 77, No 1, pp 128-137, 1967. 10 p, 7 fig, 2 tab.

Descriptors: *Moisture stress, Arizona, Phenology.
Identifiers: Turgidity, Vegetation continuum.

Numerous observations of desert vegetation were made north of Phoenix, Arizona along a topographic gradient which extended from Paradise Valley to Carefree with elevations of 425 and 760 meters respectively. The vegetation varied from rather widely dispersed low shrubs at the lowest elevation to relatively dense tall shrubs at the highest elevation. Measurements of relative turgidity, a measure of moisture stress, were made on twigs collected weekly from Feb 21 to May 15, 1964, at four stations along the gradient. It was concluded that the vegetation continuum was correlated with moisture stress. Phenological data suggested that differences in plant moisture stress along the continuum influenced the composition of the continuum markedly. (Affleck-Ariz)
W68-01103

A COMPARISON OF GYPSUM BLOCKS AND EVAPORIMETERS FOR IRRIGATION CONTROL,
Department of Agriculture, Werribee, Victoria, State Research Farm.
L. F. Bartels.
Aust J of Exp Agr and Animal Husb, Vol 5, No 19, pp 453-457, Nov 1965. 5 p, 5 fig.

Descriptors: *Irrigation, *Bouyoucos blocks.
Identifiers: *Evaporimeters.

A comparison of predictability, from gypsum block and evaporimeter measurements, of water storage within the effective root zone of an irrigated perennial pasture was made in Australia. Data was collected from an irrigation experiment in which the quantity of water stored in the top two feet of soil was determined for each treatment immediately before irrigation. These readings along with corresponding average moisture bridge readings and evaporimeter records form the basis of the comparison. Using regression relationships it was shown gypsum block resistance was a better guide to water storage than was an evaporative index. Over a number of seasons drift in block calibration reduced the association below that found for the evaporative index. (Affleck-Ariz)
W68-01104

EVAPOTRANSPIRATION RATES OF FIELD CROPS DETERMINED BY THE BOWEN RATIO METHOD,
U S Dept of Agriculture, Agricultural Research Service, Phoenix.
Leo J. Fritschen.
Agronomy J, Vol 58, No 3, pp 339-341, May-June 1966. 3 p, 1 fig, 2 tab.

Descriptors: *Evapotranspiration, Arizona, Field crops, Irrigation.
Identifiers: *Bowen ratio.

Evapotranspiration rates of crops grown under irrigated conditions in the hot, arid region of south-central Arizona were determined from meteorological data by the Bowen Ratio. The crops used in the study consisted of alfalfa, barley, cotton, sorghum, wheat and oats. Alfalfa tended to use more water than the other crops while barley, wheat and grain sorghum required the least water. Calculated evapotranspiration rates ranged from 1.0 to 1.8 times net radiation, indicating that large amounts of energy were extracted from the air mass. It was concluded that the Bowen ratio method, as a survey technique or continuous sampling method, could be used to obtain short period evapotranspiration rates under field conditions. (Affleck-Ariz)
W68-01106

MOISTURE AND TEMPERATURE REQUIREMENTS FOR GERMINATION OF THREE ANNUAL SPECIES OF MEDICAGO,
CSIRO, Canberra, ACT, Division of Plant Industry.
For primary bibliographic entry see Field 02I.
For abstract, see .
W68-01107

SOME PHYSICAL ASPECTS OF INTERNAL CONTROL OF LEAF TRANSPIRATION,
CSIRO, Canberra, Australia.
For primary bibliographic entry see Field 02D.
For abstract, see .
W68-01109

SUGAR CANE IRRIGATION: A CASE STUDY IN CAPITAL BUDGETING,
McKinsey and Company, Inc., San Francisco, Calif.
Robert R. Champion, and R. George Glaser.
Manage Sci, Vol 13, No 12, pp B-781-796, Aug 1967. 16 p, 5 fig, 2 ref.

Descriptors: *Linear programming, Alternative costs, Discount rate, Economic efficiency, Evaluation, *Irrigation design, *Irrigation efficiency, Fixed costs, Annual costs, Investment, *Sugarcane, Capital, Budgeting, Future planning (Projected).
Identifiers: Hawaii, Present value, Sensitivity analysis.

Linear programming techniques were used to help solve the problem of optimum investment outlay for irrigation works on a sugar plantation. Adjacent fields were grouped into 'blocks' to reduce the alternatives to be studied. Various systems of irrigation were tried on different blocks. Initially, individual 'system/block' alternatives were evaluated using sensitivity analyses to reduce the number of alternatives. Ranking criteria used to compare alternatives were (1) net present value of future cash flow (using 3 discount rates); (2) 'years-to-payback' (with no cash discounting); and (3) 'source water contribution' (reflecting the increase in efficiency of irrigation water reaching the root zone). Two sets of data were used in the model, present system data and proposed alternative system data. After single systems for each block were chosen, the model was used to determine total net plantation return. Sensitivity analyses were used to evaluate the effect of changes in physical and economic parameters.
W68-01164

ARID-ZONE AGROMETEOROLOGY IN INDIA,
Meteorological Office, Poona, India.
For primary bibliographic entry see Field 02B.
For abstract, see .
W68-01171

SPRING SLOPE RUNOFF FROM THE PRINCIPAL AGRICULTURAL LANDS OF THE KULUNDA STEPPE,
USSR Academy of Sciences, Novosibirski, Institute of Hydrodynamics, Siberian Branch.
For primary bibliographic entry see Field 02C.
For abstract, see .
W68-01174

GEOGRAPHIC DISTRIBUTION AND FACTORS AFFECTING THE DISTRIBUTION OF SALT DESERT SHRUBS IN THE UNITED STATES,
USGS, Water Resources Division, Denver, Colorado.
For primary bibliographic entry see Field 02I.
For abstract, see .
W68-01176

FACTORS AFFECTING THE EMERGENCE OF SUGAR BEETS IN AN IRRIGATED DESERT ENVIRONMENT,
California Univ., Davis; Imperial Valley Field Station, El Centro.
Frank E. Robinson, and George F. Worker, Jr.
Agronomy J, Vol 58, No 4, pp 433-435, July-Aug 1966. 3 p, 1 fig, 5 tab.

Descriptors: Soil-plant-water relationships, *Sprinkler irrigation, *Germination, *Furrow irrigation, Soil temperature, *Sugar beets, Southwest US, Irrigation practices.
Identifiers: Imperial Valley.

A study was conducted to the Imperial Valley of California to investigate the influences of the irrigation regime of timing and water quality on the emergence of sugar beets. Sprinkler irrigation was shown to be the most effective in removing surface salt accumulations and gave the highest emergence. Six-day, intermittent furrow irrigation gave significantly better emergence than did continuous furrow irrigation. A greater air volume in the drier soil was shown to be a contributing factor. Each of the three irrigation methods reduced soil temperature approximately 20 deg F below the unirrigated soil. (Affleck-Ariz).
W68-01187

EFFECTS OF REPEATED DROUGHT PERIODS ON PHOTOSYNTHESIS AND SURVIVAL OF CEREAL SEEDLINGS,
Oklahoma State Univ., Stillwater.
Glenn W. Todd, and Daniel L. Webster.
Agronomy J, Vol 57, No 4, pp 399-404, July-Aug 1965. 6 p, 4 fig, 2 tab.

Descriptors: *Drought tolerance, *Cereal crops, Photosynthesis.

A study was conducted in Stillwater, Oklahoma to determine whether there were intrinsic differences in photosynthetic rates between drought tolerant and susceptible cereals; whether they differed in their ability to photosynthesize when at below-normal turgor; and whether they differed in the rate at which they photosynthesize after being rewatered. There were no significant differences in photosynthetic rate among wheat varieties differing in drought hardiness. During successive drought periods photosynthetic rates paralleled moisture stress. A method of screening for relative drought hardiness among wheat varieties was devised and tested and this correlated well with known field hardiness. (Affleck-Ariz.)
W68-01188

EFFECT OF SOIL MOISTURE DEPLETION ON CROP YIELD AND STOMATAL INFILTRATION,
American University of Beirut, Beirut, Lebanon.
H. D. Fuehring, A. Mazaheri, and M. Bybordi.
Agronomy J, Vol 58, No 2, pp 195-198, March-April 1966. 4 p, 4 fig, 4 tab.

Descriptors: *Irrigation effects, Timing, *Stomata, Plant growth, Crop production, Irrigation practices, Moisture stress, Soil-plant-water relationships.

Experiments were conducted in Beirut, Lebanon to determine the effect of irrigation interval on soil moisture and crop yields under field conditions and to investigate the use of the leaf infiltration technique on various crops as an indicator of moisture relationships. Yields of maize, potatoes, and sugar beets were decreased as the interval between irrigations was extended beyond one week. Partial closure of stomata as early as two days after irrigation indicated stress on plant growth even when most available soil moisture was present. A linear relationship between degree of stomatal opening as measured by the oil-drop penetration technique and the length of time after irrigation of various crops was established under field conditions. (Affleck-Ariz.)
W68-01189

TRANSPIRATION PATTERNS OF WHEAT, BARLEY AND OAT SEEDLINGS UNDER VARYING CONDITIONS OF SOIL MOISTURE,
Oaklahoma State Univ., Stillwater.
M. H. Salim, and Glenn W. Todd.
Agronomy J, Vol 57, No 6, pp 593-596, Nov-Dec 1965. 4 p, 3 fig, 3 tab.

Descriptors: *Transpiration, Cereals, *Drought resistance, Stonata, Moisture stress.

Transpiration rates of wheat, barley, and oats were measured under greenhouse and growth chamber conditions to determine the effect of transpiration on drought resistance. Barley showed the lowest transpiration rates and oats the highest under all conditions. After plants were subjected to one period of moisture stress their transpiration rates after rewatering were always much reduced from the pre-stress rates. Stomatal frequency in barley leaves was nearly twice and stoma length was about one half that of wheat when both were grown under adequate conditions with regard to moisture. It was concluded that the observed differences in behavior of these cereals could contribute in large measure to the differences in drought hardiness observed in the field. (Affleck-Ariz)
W68-01190

OVERHEAD IRRIGATION ENCOURAGES WET-WEATHER PLANT DISEASES,
California Univ, Berkeley and Davis; Office of the Agricultural Commissioner, Monterey Co, Calif.
W. C. Snyder, R. G. Grogan, and R. Bardin.
California Agri, Vol 19, No 5, p 11, May 1965. 1 p.

Descriptors: *Sprinkler irrigation, Plant diseases, Irrigation practices.

Confirmation of previous research regarding wet-warm-weather diseases such as halo blight, anthracnose, black rot, leaf spot and early blight was made in California. Infected seed grown with furrow irrigation showed no evidence of blight while infected seed grown under overhead sprinkling was completely lost. Free moisture, made available by overhead sprinkling and one of the factors necessary to the disease, was removed and the disease was cleared. (Affleck-Ariz)
W68-01192

INTEGRATING FARM AND WATERSHED PLANNING IN SOIL AND WATER RESOURCE MANAGEMENT,
Ministry of Agriculture, Winnipeg, Canada; Iowa State University, Ames.
Murray Cormack, and John F. Timmons.
J Soil Water Conserv, Vol 23, No 3, pp 84-88, May-June 1968. 5 p, 2 tab, 1 photo.

Descriptors: *Watersheds, *Farm units, *Soil management, Crops, Water resources, Planning, Soil conservation, Soil erosion, Capital costs, Optimum development plans, Damages, Flood damages, Runoff, Livestock.
Identifiers: *Watershed management, *Small watersheds, Farms, Income, Revenues, Hound Dog Creek Wtrshed, Ia, Demonstration watersheds.

Farm and watershed planning should be integrated for more efficient management of soil and water resources in small watersheds. The watershed Protection and Flood Prevention Act passed by the Congress in 1954 recognized the need to bridge the gap between programs serving individual farms and those aimed at multipurpose resource development within large river basins. The objective of watershed development is to maximize net returns over a future period. This is accomplished either through reorganization of existing resources or organization of additional available resources. In the small watershed context, participants may include farm operators; local, state, and federal governments; and urban areas and downstream (off-watershed) beneficiaries. A watershed area of 3140 acres in Iowa containing all or parts of 20 farms was selected for study. Net returns to watershed participants over a 50-yr planning period were examined under three alternative situations, and two sets of optimal plans were developed for farms for the planning periods. Results are discussed. (USBR)
W68-01234

ADSORPTION CATALYZED CHEMICAL HYDROLYSIS OF ATRAZINE,
Wisconsin Univ. Madison.
David E. Armstrong, and Gordon Chesters.
Environ Sci and Technol, Vol 2, No 9, pp 683-689, Sept 1968. 7 p, 4 fig, 3 tab, 12 ref.

Descriptors: *Pesticide kinetics, *Adsorption, *Hydrolysis, *Phytotoxicity, Pesticide toxicity, Soil contamination, Chlorinated hydrocarbon pesticides.
Identifiers: Atrazine, Hydroxyatrazine.

Results are given of studies made concerning the adsorption of atrazine on soil and model adsorbents as it affects atrazine hydrolysis. Of the adsorbents studied only soil and a carboxylic resin affected hydrolysis rate. High adsorption capacities were exhibited by phenolic resin, cellulose acetate and monmorillonite, but they had no effect on hydrolysis. The first-order rate constant for atrazine hydrolysis in reactions on soil and carboxyl resin was related to the extent of adsorption; the rate was higher, for the same adsorption, on carboxyl resin than on soil. Hydrolysis apparently resulted from hydrogen bonding between the adsorbent carboxy and atrazine ring nitrogen atom. (Knapp-USGS)
W68-01246

PROGRESS REPORT ON WEST TEXAS AND EASTERN NEW MEXICO IMPORT PROJECT INVESTIGATION.
U. S. Bureau of Reclamation.

U. S. Bur of Reclam, Washington, D. C., 92 p, May 1968. 11 fig, 8 plate, 25 tab.

Descriptors: *Irrigation, *Multiple-purpose projects, *Cost-benefit ratio, *Water resources development, *Inter-basin transfers, Texas, New Mexico, Irrigation canals, Irrigation districts, Irrigation effects, Irrigation engineering, Federal government, Planning, Water conveyance, Water transfer, Mississippi River.
Identifiers: High Plains, Texas-New Mexico, Water import project.

The problem of importing water to the High Plains of west Texas and New Mexico has been studied by thoroughly reviewing the literature of geography, geology, and agriculture. Comparative analyses of conveyance works, storage facilities, and distribution systems have been made by preliminary reconnaissance methods on the basis of available maps and engineering, geologic, and hydrologic data, with a minimum of field work. It is physically feasible to transport the projected water requirements for the year 2,020 of 16.5 million acre-ft per yr from the lower Mississippi to the High Plains if water is available. Of the routes studied, the southern ones are the better as they avoid mountains and use the navigation works of the Arkansas. The cost of water delivered to farmers would substantially exceed their ability to pay, but economic benefits of irrigation to non-farm interests appear to warrant their payment of part of the cost of water import. Cost could be reduced and feasibility enhanced by making the project multiple-purpose. More investigation is recommended. (Knapp-USGS)
W68-01271

PROTECTING OUR WATER RESOURCES,
Committee on Bar Ass'n Q, Harrisburg, Pa.
Grover C. Ladner.
Penn Bar Ass'n Q, Vol 23, No 1, pp 35-42, October, 1951. 8 p.

Descriptors: *Reforestation, Forests, Rainfall, *Retention, Rainfall disposition, Runoff, *Vegetation effects, *Water conservation, Forest management, Water pollution, Water pollution control, Pollution abatement, Water treatment.

In an address delivered to the Pennsylvania Bar Association, Justice Grover Ladner of the Supreme Court of Pennsylvania presented his views on the correlation of prosperity and water supply. He emphasized that civilization depends on an abundant supply of water. Justice Ladner's conclusion that an increasing shortage of water was undermining opportunities for future economic growth and human production caused him to recommend as remedies: (1) A sustained program of reforestation; (2) Increasing pollution abatement control. He supported his recommendation for reforestation with a comparison of rainfall retention in forested areas and unforested areas. Forested areas retain 85% of the rainfall while 90% is lost in an unforested area. With a view toward implementing a plan of reforestation, Justice Ladner suggested postponing payment of taxes by growers until the day he harvested his crop of trees. Municipal sewage and industrial discharge were described as the major causes of water pollution. Justice Ladner cited several examples where cities and plants had installed water treatment facilities with resulting purification of watercourses. He exhorted the members of the bar to profit by these examples and to direct their influence toward achieving pollution control. (Harriett-Fla)
W68-01345

THE ADMINISTRATION OF WATER LAWS IN FLORIDA,
Institute of Law and Government, College of Law, Georgia Univ, Athens.
For primary bibliographic entry see Field 06C.
For abstract, see .
W68-01356

A SYMPOSIUM ON SUPPLEMENTAL IRRIGATION.
Interstate Comm'n on the Potomac River Basin, Washington.

Symposium on Supplemental Irrigation, pp 1-44, May 12, 13, 1955. 44 p, 5 photo.

Descriptors: Legislation, Prior appropriation, Riparian rights, Water resources development, Soils, Water districts, Irrigation districts, Irrigation programs, *Future planning, Research and development, Water allocation.

To support our rapidly expanding economy an ever increasing quantity of water is needed. Our present legal system is inadequate to meet the ever increasing needs. Too often the solution is to turn to the Federal Government for financial aid rather than seeking a solution on the state or local level. However any legislative action should be approached with caution. Elementary principles of the riparian system of the Eastern U. S. are discussed. The following are goals which any new riparian code should contain. (1) Encourage the maximum beneficial use of water and reduce waste; (2) encourage argicultural resource development in conformity with the basic capabilities of the land; (3) make secure the investment of water user; (4) clarify legal rights to the use of water; (5) bring about a further reduction in the destructive forces of water; (6) provide an effective administrative means for guiding people in the balanced use of water. Elementary aspects of western water law are discussed with the conclusion that western water law is one of the great legal systems of the modern world because it is a demonstration of the ability of man, in a changing environment, to assume his political responsibilities. The best way for eastern systems to develop their water law is through soil conservation districts and organized studies.
W68-01396

04. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control of Water on THE Surface

MAGNITUDE AND FREQUENCY OF FLOODS IN THE UNITED STATES PART 5. HUDSON BAY AND UPPER MISSISSIPPI RIVER BASIN,
U. S. Geological Survey.
For primary bibliographic entry see Field 02E.
For abstract, see .
W68-01023

CUCAMONGA CREEK, SAN BERNARDINO AND RIVERSIDE COUNTIES, CALIFORNIA (FLOOD CONTROL PROPOSAL).
U. S. Army Corps of Engineers, Wash., D. C., Office of Chief of Engineers.
For primary bibliographic entry see Field 06F.
For abstract, see .
W68-01033

FEATHER RIVER NEAR CHESTER, CALIFORNIA (FLOOD CONTROL).
U S Army Corps of Engineers, Wash, D. C. Office of Chief of Engineers.

U S 90th Congr, 2d Sess, House Doc No 314, 124 p, 1968. 2 plate, 1 chart, 3 append.

Descriptors: *Floods, *Flood control, *Diversion structures, *Cost-benefit ratio, *Floodways, Stage-discharge relations, Hydrologic data, Flow characteristics, California, Channel improvements, Flood routing, Flood protection, Fish passages.
Identifiers: *Feather River, *Chester, California, Flood data.

A plan of improvement consisting of a structure to divert excess water from the channel of the North Fork of the Feather River into an old channel leading into Lake Almanor, to bypass Chester, is proposed. Most of Chester is on an alluviating flood channel. Water and debris damages are severe in the frequent floods. The description of the area includes streamflow and channel characteristics, flood control improvements, and recreational, water resource, and industrial improvements. Hydrologic data, flood history, flood frequency, and floods of record are compiled. Flood damages and predictions of future flood damages are listed. The plan of improvement is presented as well as other proposals and solutions. Costs and cost-benefit ratios are calculated and listed. The results of public hearings and the comments of other government agencies, local and federal, are listed and discussed. Appendixes present hydrologic data, flood damage data, project design, and cost-benefit data. Maps and plans show location and design of structures. (Knapp-USGS)
W68-01037

STREAMS IN DUTCHESS COUNTY, NEW YORK--THEIR FLOW CHARACTERISTICS AND WATER QUALITY IN RELATION TO WATER PROBLEMS,
U. S. Geological Survey.
G. R. Ayer, and F. H. Pauszek.
N Y State Water Resource Comm Bull 63, 105 p, 1968. 23 fig, 6 plate, 32 tab, 27 ref.

Descriptors: *Streamflow, *Duration curves, *Hydrographs, *Floods, *Surface waters, Frequency analysis, Flow characteristics, Peak discharge, New York, Hudson River, Hydrologic data, Water management (Applied), Data collections, Stream gages, Average flow.
Identifiers: *Dutchess County, Flow duration, Annual flow, Flow frequency, Water availability.

Records of stream flow from 1928 to 1968 in Dutchess County, New York, are analyzed and tabulated. Dutchess County, on the east side of the Hudson River between Albany and New York City, has an average rainfall of 40 in., which varied from 25.98 in. to 55.83 in. in the period 1932-65. Total water use is about 26 mgd, of which 8 mgd is from the Hudson and 18 mgd is from smaller streams; use may triple by 2010. The Hudson and its 2 largest tributaries in the county flow an average of 543 mgd. The range in flow in Wappinger Creek in the same period was from 0.9 cfs to 18,600 cfs, the average was 236 cfs; 90% of the time flow exceeded 21 cfs. Other streams had similar behavior. Flow was maintained even in severe droughts. Flooding is frequent and severe. The floods of 1938 and 1955 were the worst of record. Chance of flooding is greatest from Dec to Apr but floods frequently occur at other times. The surface water is hard; its hardness exceeds 109 ppm 95% of the time and averages 145 ppm. Water storage projects are needed to assure supplies at low flow and alleviate flooding at high flow. (Knapp-USGS)
W68-01042

STREAMFLOW FLUCTUATION, BAR ROUGHNESS, AND BED LOAD MOVEMENT: A HYPOTHESIS,
Oregon College of Education, Monmouth.
For primary bibliographic entry see Field 02E.
For abstract, see .
W68-01044

ECONOMIC ANALYSIS OF ALTERNATIVE FLOOD CONTROL MEASURES,
Kentucky Univ., Lexington. Dept. of Civil Engineering.
For primary bibliographic entry see Field 06F.
For abstract, see .
W68-01052

HYDROGRAPHS OF EPHEMERAL STREAMS IN THE SOUTHWEST,
U. S. Dept. of Agriculture, Tucson Agricultural Research Service.
Kenneth G. Renard, and Robert V. Keppel.
J Amer Soc of Civil Engineers, Vol 92, No HY2, Proc Paper 4710, pp 33-52, March 1966. 20 pp, 14 fig, 3 tab, 17 ref.

Descriptors: *Hydrographs, *Ephemeral streams, Arid lands, Semiarid climates, *Storm runoff, *Transmissivity, Alluvial channels, *Peak discharge, Watersheds (Basins), Parametric hydrology, Waves (Water), Flow rates.
Identifiers: Walnut Gulch Experimental Watershed, Arizona, Alamogordo Creek Experimental Watershed, New Mexico, Translatory waves.

The areas under study were the Walnut Gulch Experimental Watershed in southeastern Arizona and the Alamogordo Creek Experimental Watershed in east central New Mexico. The downstream hydrograph in arid and semi-arid areas of the Southwest is greatly affected by storm pattern, high intake rates in the coarse-textured alluvial stream beds that are typical for the area and by overriding translatory waves developed in the channels. The hydrograph parameters of peak-volume correlations, hydrograph rise time, transmission losses, translatory waves and dimensionless hydrographs are discussed for each watershed and comparisons are made between the watersheds. Total runoff volumes for simple event were highly correlated with peak discharge for the event. Hydrograph rise time decreased with increasing watershed area within the range of areas included in the study. Transmission losses had a pronounced effect on the hydrograph shape. The Alamogordo Creek Watershed fell in a different class than the Walnut Gulch Watersheds. Conventional unit-hydrograph techniques were not well adapted to synthesis of hydrographs of runoff from watersheds in the Southwest that had ephemeral streams. (Blecker-Ariz)
W68-01092

COMPUTER MODELS FOR RESERVOIR REGULATION,
Cornell Univ., Ithaca, N. Y.
For primary bibliographic entry see Field 06A.
For abstract, see .
W68-01154

DISPERSION IN LAYERED POROUS MEDIA,
Dept. of Civil Engineering, Massachusetts Institute of Technology, Cambridge, Massachusetts.
For primary bibliographic entry see Field 08D.
For abstract, see .
W68-01178

DEPTH OF DRAINAGE IN IRRIGATED AREAS,
University of California, Davis.
James N. Luthin, and Frank Robinson.
Pap No 68-205, Annu Meeting, Amer Soc Agr Eng, Logan, Utah, June 1968. 11 p, 1 tab, 6 ref.

Descriptors: *Drainage, Soils, *Salinity, Salts, Capillarity, Water table, Hydraulic conductivity, Infiltration, Stratification, Irrigation practices, Field investigations, *Tile drains, Irrigation, *Subsurface drains.
Identifiers: *Drains, *Depth, Root zone, Alfalfa, Cropping patterns, *Shallow drains, Saline soils, Imperial Valley, Calif, California.

Field experiments in the Imperial Valley of Calif indicate that in soils having stratification and low infiltration rates, shallow drain lines may be more effective in controlling soil salinity than the present practice of placing drains at depths in excess of 6 ft. The depth of drainage was related to factors other

than capillary rise from the water table. These factors include infiltration rate, soil stratification, salinity of irrigation water, cropping pattern, and irrigation practices. Capillary rise from the water table may be a minor factor in accumulating salts in the plant root zone in soils of low to moderate hydraulic conductivity. The major factor is salt contained in irrigation water and the fact that insufficient irrigation water can be applied to satisfy the leaching requirement because of low soil hydraulic conductivity. The leaching requirement can be satisfied by normal irrigation practices in sandy soils of high hydraulic conductivity. In these soils the rate of movement of water by capillary action is sufficiently high that salts will accumulate in the root zone if the soil is left fallow. Capillary rise from the water table is a major cause of salinization of soil of high hydraulic conductivity. (USBR)
W68-01231

THE CONTROL OF WATER WEEDS,
ARC Weed Research Organization, Oxford, Great Britain.
E. C. S. Little.
Weed Res, Vol 8, No 2, pp 79-105, June 1968. 27 p, 363 ref.

Descriptors: Bibliographies, *Aquatic weeds, Reviews, Water resources, *Weed control, Weeds, Water development, Lakes, Reservoirs, *Herbicides, Canals, Operation and maintenance, Toxicity, Water conservation, Fish, Chemicals, Plant (Botany).
Identifiers: Foreign research, Great Britain, Nutrients, Biocontrol, Water hyacinths, Weed growth, *Aquatic weed control, Aquatic plants.

Aquatic weeds are causing increasing problems in many countries dependent on water control for development of agricultural, power, and transport resources. Heavy water weed infestations are to be expected when fertile land is submerged to form lakes, or when lakes and channels become silted. The problems are accentuated in developed countries by extra plant nutrients in water supplies from agricultural fertilizers and sewage effluents. The U S is becoming concerned with the aquatic weed impairment of the increasingly popular recreational uses of water. Aquatic weed literature throughout the world is reviewed to provide a guide to research since 1960, with particular emphasis on plants causing trouble in warm environments. The literature review is grouped as follows: Reviews, Identification, General Recommendations, Important Water Weeds, Herbicides for Aquatic Weeds, Control Techniques, Biological Control, Utilization of Water Weeds, Toxicology of Herbicides to Fish, Herbicide Residues, and Water and Its Effects. Literature citations include references to Weed Abstracts. (USBR)
W68-01235

RECLAMATION OF THE RAJPUTANA DESERT,
University of Udaipur, India; Central Arid Zone Research Institute, Jodhpur, India.
D. K. Misra, Ram Prasad, and Suraj Bhan.
World Crops, Vol 20, No 3, pp 18-24, June 1968. 7 p, 8 fig, 29 ref.

Descriptors: *Land reclamation, Soil conservation, Agriculture, Dry land farming, Water conservation, *Deserts, Forestry, Windbreaks, Trees, Bibliographies, Wind (Meteorology), Grazing land, Land development, Arid land, *Land utilization, Vegetation, Reforestation, Strip cropping, Grasses.
Identifiers: Shrubs, *Shelterbelts, *Wind erosion, Foreign research, India.

The Central Arid Zone Research Institute, Jodhpur, India, started desert control work on the Rajputana Desert in 1952. Analysis of conditions shows that the desert is largely man-made and could be corrected by human efforts. Desert control work consists of (1) proper control of grazing, (2) utilization of trees and bushes, (3) afforestation of sand dunes and rocky refractory sites, and (4) creation of windbreaks and shelterbelts to protect the inroads of the desert and improve dry-farming practices. These control measures are discussed, identifying species of grasses, shrubs, and trees best suited for the climatic conditions, describing improvement in farming methods through education, and stressing the importance of good practices and benefits derived. (USBR)
W68-01242

CHEMICALS MAY CONTROL STUBBORN ALLIGATORWEED,
Auburn Univ.
H. H. Funderburk, Jr., and D. A. Pate.
Crops and Soils, November 1965. 1 p, 1 fig.

Descriptors: *Alligatorweed, *Herbicides, *Aquatic weed control, Aquatic plants, Reproduction, 2-4 D, Diquat, Paraquat.
Identifiers: *Silvex, *Diglycolic acid, Dormancy, Axillary buds.

Alligatorweed is a large, highly differentiated vascular plant and is a true amphibious plant because it grows in dry soil as well as swampy areas and open water. This weed is primarilary a problem in fresh water near the Gulf and Atlantic coasts. Alligatorweed has opposite leaves. In the axil of each leaf there is a bud capable of giving rise to a new plant. Reproduction is usually by vegetative means. Because of the vegetative reproduction of dormant buds, chemical control has been extremely difficult. The tissues between the node and bud were not sufficiently differentiated to translocate or move enough herbicide into the bud to cause its destruction as shown in several experiments. Chemicals that show promise are various combinations of 2,4-D, diquat, paraquat, silvex, and diglycolic acid. (Daly-Auburn)
W68-01277

THE EFFECT OF DICHLOBENIL AND DICAMBA ON NODAL TISSUES OF ALLIGATORWEED,
Auburn Univ.
D. A. Pate, H. H. Funderburk, Jr., and J. M. Lawrence.
Weeds, Vol 13, No 3, pp 208-210, July 1965. 3 p, 5 fig, 6 ref.

Descriptors: *Herbicides, *Aquatic plants, *Alligatorweed, *Dichlobenil, Water, Aquatic weeds, Floating plants, Translocation, Aquatic weed control.
Identifiers: *Dicamba, *Axillary buds, Vegetative reproduction, Photomicrographs.

Effective chemical control of alligatorweed (Alternanthera philoxeroides (Mart.) Griseb.) has been prevented by rapid regeneration of plants from inactive axillary buds following treatment with herbicides. Destruction of phloem, cambium, and associated parenchyma occurred above and within the nodes of plants treated with 2 lb/A dichlobenil (2,6-dichlorobenzonitrile) or dicamba (2-methoxy-3, 6-dichloro-benzoic acid). Application of dichlobenil and dicamba in combination increased the extent of tissue destruction. Herbicidal activity was noted within the axillary buds only when vascular strands between bud and stem were well differentiated. (Daly-Auburn)
W68-01278

PERSISTENCE OF DIQUAT, PARAQUAT, AND 2,4-DBEE WHEN USED FOR EURASIAN WATERMILFOIL CONTROL,
Auburn Univ.
R. W. Daly, H. H. Funderburk, Jr., and J. M. Lawrence.
Proceedings Southern Weed Conference, Vol 21, p 299, January 1968. 1 p.

Descriptors: *Persistence, *Herbicides, *Paraquat, *Diquat, *2-4 D, Water, Aquatic plants, Weed control, Soil.
Identifiers: *Eurasian watermilfoil, *2,4-DBEE.

Analysis of water, soil, and watermilfoil samples from Lake Seminole, Georgia, showed that diquat, paraquat, and 2,4-DBEE disappeared at different rates. Paraquat and diquat were applied in a liquid formulation and 2,4-DBEE on clay granules. Water analysis revealed only a trace of paraquat and diquat could be detected after 24 hrs, whereas 2,4-DBEE concentration continued to increase during the entire sampling period. In soil, paraquat was highest in initial concentration, and 2,4-DBEE was next. Diquat could not be detected in any soil sample. Watermilfoil herbicide concentration was highest at 7 days, with paraquat having the highest concentration followed by diquat and 2,4-DBEE. Control of the watermilfoil for a short time period was obtained with paraquat and a combination of paraquat and diquat as compared with poor control with diquat. 2,4-DBEE controlled watermilfoil and appeared to remain effective against reinfestation for a much longer period than paraquat and diquat. Growth chamber studies of diquat and paraquat treated milfoil substatiated the lake analysis results. (Daly-Auburn)
W68-01279

EFFECTIVENESS OF HERBICIDAL COMBINATIONS ON ALLIGATORWEED GROWING IN FLOWING WATER,
Auburn Univ.
J. M. Lawrence, and H. H. Funderburk, Jr.
Proceedings Southern Weed Conference, Vol 18, pp 558-566, January 1965. 9 p, 4 fig, 1 tab.

Descriptors: *Herbicides, *Alligatorweed, *River flow, *Aquatic weed control, Reservoirs, Water hyacinth, 2-4 D, Paraquat, Emulsifiers, Diquat, Dichlobenil, Evaluation, Sewage, Absorption.
Identifiers: Silvex, Diglycolic acid, Dicamba, Picolinic acid, MCP, 2,4-DBEE, Retreatment, Tordon.

Rooted growths of alligatorweed in Flint River arm of Jim Woodruff Reservoir were treated with numerous combinations of herbicides during 1964. Treatments were initiated last week of March and were terminated in mid-September. Applications to one-quarter and one-acre plots were made at monthly intervals. Treatments in March and April were considered rather ineffective in the seasonal treatment program. This was partially due to insufficient plant growth for absorption of herbicides. Retreatments at monthly intervals were inefficient due to insufficient growth of alligatorweed plants within the periods for effective absorption of herbicides. Additons of food-grade emulsifiers at rates of 2 lbs/A to spray solutions greatly enhanced herbicidal activity of chlorophenoxy and bipyridyl compounds applied in June and later in the growing season. Reductions of 30-40 percent in alligatorweed populations within plots were obtained with combinations of several herbicides and emulsifiers. (Daly-Auburn)
W68-01280

ABSORPTION, TRANSLOCATION, AND METABOLISM OF C-14-LABELED DICHLOBENIL,
Auburn Univ.
D. A. Pate, and H. H. Funderburk, Jr.
In Isotopes in Weed Research, Proceedings of a Symposium, Vienna, IAEA and FAO, pp 17-26, October 1965. 10 p, 3 fig, 1 tab, 21 ref.

Descriptors: *Herbicides, *Dichlobenil, *Metabolism, Alligatorweed, Absorption, Translocation, Fungi, Volatility.

Autoradiographs of bean and alligatorweed indicated that dichlobenil was slightly absorbed by the leaf and some translocation occurred. Roots submersed in aqueous solutions absorbed and translocated the dichlobenil throughout the plant. An investigation of some of the chemical and physical properties of dichlobenil was conducted. Two higher plants and four fungi were selected for metabolism studies. Dichlobenil was added to nutrient solution containing beans or alligatorweed and to liquid cultures of the other organisms. Ex-

tracts were chromatographed and autoradiographed, revealing a labeled compound other than dichlobenil. This was shown to be methyl-2,6-dichlorobenzoate and increased with time of exposure of the various test organisms to C-14-dichlobenil. (Daly-Auburn)
W68-01283

EFFECT OF MORPHACTINS ON BEAN AND ALLIGATORWEED,
Auburn Univ., Auburn, Alabama.
A. W. Atkinson, Jr., and H. H. Funderburk, Jr.
Abstracts, 44th Annual Meeting, Alabama Academy of Science, pp 317-318, April 1967. 2 p.

Descriptors: *Alligatorweed.
Identifiers: *Morphactins, *Gibberellic acid, *Morphological effects.

Bean and alligatorweed were treated with a morphactin. Root and foliar application of methyl-2-chloro-9-hydroxyfluorene- (9)-carboxylate were made to determine specific morphological effects. Combination treatments of morphactin and gibberellic acid were made to study the possibility of action as an anti-gibberellin. Stems of treated alligatorweed were found to be curved downward, leaf color was darker, and internode length was reduced in all treated plants. One month after treatment irregular leaf development still occurred. Similar effects were observed on beans. Bean plants treated with gibbelellic acid then with an equal concentration of morphactin after the gibbelellin spray had dried, showed somewhat normal stem elongation; however, some leaves exhibited symptoms of slight injury. Dry and fresh weight determinations indicated that gibberellin caused some reversal of the morphactin effect. (Daly-Auburn)
W68-01284

CLASSES OF WATER AND CHARACTER OF WATER RIGHTS AND USES - SECTION 52: THE PRINCIPAL CATEGORIES OF SURFACE AND GROUND WATERS,
For primary bibliographic entry see Field 06E.
For abstract, see .
W68-01291

PALM BEACH COUNTY WATER AND SEWER ACT.

Fla Laws 1967, ch 67-1880, pp 3424-3448, 25 p.

Descriptors: *Florida, *Legislation, Financing, Water law, Water supply, Construction, Administration, Local government, Sewage districts, State governments, Government finance, Sewage disposal.
Identifiers: Bonds, Palm Beach County.

This is an act of the Florida Legislature authorizing the county of Palm Beach, Florida, to provide for the construction, acquisition or purchase of water or sewer systems or any combination thereof and improvements, additions and extensions thereto and the operation and maintenance thereof. The Act provides for optional methods of financing such construction, acquisition, purchase, or improvement by issuance of revenue bonds or assessment bonds, or any combination thereof of said county; and provides for the fixing and collecting of rates and charges to users of such systems to pay such revenue bonds, and for the levy and collection of special assessments on property benefited by the construction or acquisition of such systems to pay such assessment or revenue bonds. The Act provides for rights, remedies, and security of the holders of any such bonds, and provides that this act will take effect upon its becoming law. This Act consists basically of a broad authorization of the county to act, and detailed provisions for financing. (Kirkconnell-Fla)
W68-01303

PRESENT WATER LAW AND PROGRAMS.

In Water For The Future In Mississippi, Chapter V, pp 29-48, Sept 1955. 20 p, 6 fig, 52 ref.

Descriptors: *Water law, Surface runoff, *Water resources development, Watercourses (Legal), Navigation, Flood control, Drainage programs, Flood prevention, Multiple-purpose projects, Watersheds (Basins), *Watershed management, Surface-groundwater relationships, Surface waters, Riparian rights, Ownership of beds, Prescriptive rights, Legal aspects.

This section explains the present and proposed surface water development programs and contains a review, with numerous definitions, of the Mississippi law concerning defined watercourses and diffused surface waters. The water rights law of Mississippi is largely the common law as developed by the courts with minor changes made by statute and the Constitution. This body of law has been geared more to disposal of water and navigation than to consumptive or non-consumptive uses. Nevertheless, this existing law must be considered by water users and the legislature in seeking to build the economy of the state. (R. Smith-Fla)
W68-01346

COMMON LAW RULES REGARDING THE USE OF SURFACE AND GROUND WATER IN THE SOUTHEASTERN STATES,
Institute of Law and Government, School of Law, Georgia Univ., Athens.
For primary bibliographic entry see Field 06E.
For abstract, see .
W68-01349

REAL PROPERTY - SURFACE WATERS COMMON ENEMY RULE AMPLIFIED,
Alabama Univ. School of Law.
For primary bibliographic entry see Field 06E.
For abstract, see .
W68-01391

4B. Groundwater Management

GROUND-WATER RESOURCES OF CHOWAN COUNTY, NORTH CAROLINA,
U. S. Geological Survey.
Orville B. Lloyd, Jr.
N. C. Dept of Water and Air Resources, Ground Water Bull No. 14, July 1968. 133 p, 35 fig, 3 plate, 4 tab, 17 ref.

Descriptors: *Groundwater, *Water wells, *Hydrologic data, *Aquifers, *Water quality, North Carolina, Logging (Recording), Hydrogeology, Water table, Data collections, Water level fluctuations, Specific capacity, Water yield.
Identifiers: Well data, Periodic observations, Chowan County.

The lithology, areal extend, depth, and thickness of aquifers in Chowan County, North Carolina were determined; the storage and transmissivity of the aquifers were estimated; and water quality was determined. Located in the northeastern part of the Coastal Plain, the county has an average annual temperature of 61 deg F and annual precipitation of about 50 in. About 2,000 ft of Early Cretaceous to post-Miocene sediments underlie the area. Between the land surface and 450 ft depth there are 5 aquifers ranging in age from upper Cretaceous to post-Miocene. Aquifer A, the uppermost, is unconfined; the other 4 are artesian. Their dip is seaward, to the east and southeast. Permeable zones are sand, shale, and limestone. Yields range from less than 10 gpm in A and E to about 500 gpm in C. Water in A and B does not have excessive chloride, but has over 0.3 ppm Fe. Water in B is very hard in the southeast. Over 250 ppm chloride is found in C, D, and E in the southeast, east, and north. Withdrawal in Edenton caused a large cone of depression in C, and some chloride intrusion. Well inventory and chemical data are tabulated. Maps show aquifer thickness, chemical quality, depth to water, and locations or inventoried wells. (Knapp-USGS)
W68-01024

GROUNDWATER CONDITIONS IN THE WATERMAN WASH AREA, MARICOPA AND PINAL COUNTIES, ARIZONA,
U. S. Geological Survey.
E. E. Denis.
Ariz. State Land Dep. Water Resources Rep. No. 37, Aug 1968. 23 p, 9 fig, 3 tab, 6 ref, append of basic data, list of Dept. reports.

Descriptors: *Groundwater, *Arizona, *Hydrologic data, *Water quality, *Water levels, Water wells, Aquifers, Hydrogeology, Water table, Data collections, Groundwater basins, Groundwater barriers, Water level fluctuations, Hydrologic properties, Water Yield.
Identifiers: *Well data, Chemical analysis (Water), Waterman Wash area.

A study was made of the groundwater of the Waterman Wash area, southwest of Phoenix, Arizona, to plan proper management of the only dependable supply of water available. Waterman Wash is a NW flowing ephemeral stream which drains 400 sq mi and is tributary to the Gila River. The valley floor is 25 mi long and about 8 mi wide. The climate of the area is arid; mean annual precipitation is 7.5 in. In 1965, 19,000 ac were cleared and 10,000 were being cultivated and irrigated. Irrigation water is pumped from 44 wells. The water levels are deepest, about 400 ft, at the south and east edges of the area. Water from most of the wells contains more fluoride than is recommended for human use. Sodium and salinity hazard is high to very high, but use of the water is not presently causing any irrigation or soil problems. Because recharge is negligible, most of the water is pumped from storage and levels are declining. From 1961 to 1965, 260,000 ac-ft were withdrawn. It is estimated that 9.25 million ac-ft remain in storage. Basic data are tabulated in an appendix. (Knapp-USGS)
W68-01028

ELECTRICAL-ANALOG ANALYSIS OF GROUND-WATER DEPLETION IN CENTRAL ARIZONA,
U S Geological Survey.
T. W. Anderson.
U S Geol Surv Water-Supply Pap 1860, 1968. 21 p, 4 fig, 4 plate, 11 ref.

Descriptors: *Groundwater, *Water-level fluctuations, *Analog models, *Forecasting, *Withdrawal, Groundwater mining, Aquifer characteristics.
Identifiers: *Water-level predictions, Salt River Valley.

Groundwater data from central Arizona, including the Salt River and lower Vera Cruz River valleys, the largest irrigated areas in the State, were analyzed by electrical analog, and predictions of future water levels were made. Groundwater mining supplies 80% of the water used, and water levels decline as much as 20 ft per yr in some places. Electrical-analog methods make possible the prediction of future water levels when the results of using the model closely match field data--in this case measured water-level change since 1923. Probable depths to water are estimated assuming withdrawal continues at the 1958-64 rate. The greatest depths will be more than 700 ft near Stanfield and more than 650 ft in Deer Valley and northeast of Gilbert. South of Eloy and NW of Litchfield Park a level of more than 550 ft is predicted. Total decline from 1964-84 will range from 150-300 ft in major cones of depression and the average decline in central Arizona will be 100 ft. Maps, scaled 1:250,000 show water level, water-level decline, transmissibility, pumpage, and predicted depth to water. (Knapp-USGS)
W68-01034

GROUND-WATER RESOURCES OF UPTON COUNTY, TEXAS,
U S Geological Survey.
D. E. White.
Tex Water Develop Board Rep 78, 132 p, May 1968. 21 fig, 7 tab, 42 ref.

Descriptors: *Groundwater, *Hydrologic data, *Aquifers, *Data collections, Water wells, Logging (Recording), Chemical analysis, Water levels, Hydrogeology, Water table, Water level fluctuations, Observation wells, Specific capacity, Water yield, Texas.
Identifiers: *Well data, Pumping-test data, Drillers logs, Water level measurements, Periodic observations.

The occurrence and availability of groundwater in Upton County, Texas are analyzed and basic data tabulated. Total withdrawal was 3,928 ac-ft in 1965, of which 3,590 was from the Upper Cretaceous Trinity Sand, the uppermost aquifer in the county. All lower formations contain water too salty to use. Recharge to the Trinity Sand is about 1,100 ac-ft per yr, far less than the amount being withdrawn. The water, of the calcium sulfate type, usually has a TDS content higher than 1,000 ppm. Surface water supplies are scanty; average annual precipitation is about 12.5 in., lake evaporation, about 83 in. Because the transmissivity of the Trinity Sand aquifer is only 1,000 to 3,000 gpd per ft in the NE half of the county, 3,000 to 6,000 gpd per ft in the NE corner, and 1,000 gpd per ft in the outcrop area in the SW half of the county, wells will have small yield and must be carefully spaced to avoid interference. The data from the inventory of 622 wells, geo-physical and drillers logs, 21 pumping tests, water levels and fluctuations in level, climate, chemical analysis, and altitude of the aquifer are presented in tables and maps. A map showing areas most favorable for water development is included. (Knapp-USGS)
W68-01036

NATURAL RECHARGE IN TUCSON BASIN,
Arizona Univ., Tucson. Agricultural Experiment Station.
Wayne Clyma, and Richard J. Shaw.
Progressive Agr in Ariz, Vol 20, No 2, pp 14-15, 17, March-April 1968. 3 p, 3 fig.

Descriptors: *Natural recharge, *Aquifers, Groundwater, Arid climates, *Groundwater recharge, *Overdraft, Groundwater basins.

There is a deficit or annual overdraft of groundwater use of 100,000 acre feet in the arid Tucson, Arizona Basin. Analyses of data collected by the Agricultural Engineering Dept. of the University of Arizona showed the nature of the water problems within the Tucson Basin and suggested procedures that should be used to solve these problems. The continuing program of water level measurements has shown that even in 1965-1966 when the greatest rise occurred in an area adjacent to the streams, the interior of the basin continued its decline in water levels. The Tucson Basin aquifer has a very large potential for rapid rate of recharge and has also the capability of very large volumes of recharge. The source of water that is a renewable supply within the Tucson Basin comes from natural recharge in Santa Cruz and the Rillito Creek areas and underflow from the mountains. (Blecker-Ariz)
W68-01080

GROWTH AND DECAY OF GROUNDWATER-MOUNDS IN RESPONSE TO UNIFORM PERCOLATION,
New Mexico Institute of Mining and Technology.
Mahdi S. Hantush.
Water Resources Res, Vol 3, No 1, pp 227-234, 1967. 8 p, 1 fig, 2 tab.

Descriptors: *Groundwater recharge, Percolation, Water table.

Artifical recharge by spreading and application of irrigation waters on rectangular or circular areas is not an uncommon practice in many arid regions. The rise and fall of the water table beneath such areas is of practical interest. Solutions describing the rise and fall of the water table in response to deep percolation from such areas are developed in this article. The solutions are applicable if the rise of the water table relative to the initial depth of saturation does not exceed 50%. (Affleck-Ariz)
W68-01083

ARTIFICIAL GROUNDWATER RECHARGE THROUGH WELLS,
V. L. Hauser, and F. B. Lotspeich.
J Soil and Water Conservation, Vol 22, No 1, pp 11-15, Jan-Feb 1967. 5 p, 9 fig, 2 tab.

Descriptors: *Artificial recharge, *Recharge wells, Aquifer, Texas, *Playa lakes.
Identifiers: *Cationic polyelectrolyte.

A study was conducted in the Texas High Plains to determine whether the Ogallala formation could be successfully recharged using local surface runoff. Water was injected into the aquifer through 6-inch wells. A field recharge system effectively removed more than 90 percent of the suspended solids by flocculation and settling after treatment with a cationic polyelectrolyte and alum. The aquifer near the wells was gradually clogged during recharge by the remaining solids, however the wells were sucessfully redeveloped by bailing. Data is presented on the flow rates into wells, total water recharged, as well as electrical conductivity, and coliform organisms before and after groundwater recharge. In arid regions recharge of playa lake water is an important method for conserving water. (Affleck-Ariz)
W68-01084

EFFECTS OF SURFACE SEDIMENTS ON GROUNDWATER RECHARGE,
California Univ., Riverside; Orange County Water District.
B. L. Grover, F. K. Aljibury, and D. D. Baier.
California Agr, Vol 22, No 4, pp 12-14, 1968. 3 p, 1 fig, 1 tab.

Descriptors: *Groundwater recharge, *Sediments, Metropolitan water dist. of So Calif, Porous media.
Identifiers: Water spreading.

Water spreading, a method of groundwater recharge, was studied in the channel of the Santa Ana River, Orange County, California. Information is presented on the infiltration rates of shallow spreading ponds in areas with, and without, surface sediments to show how much the surface sediments affect the spreading efficiency of such ponds. The rate of water delivery to the spreading area was maintained at approximately 300 cubic feet per second during the period of study. The intake values were 0.088 acre feet per day in the pond with sediments and 5.9 acre feet per day in the pond with sediment removed. The use of underground storage for water has become an operation of major importance in arid regions in recent years. (Affleck-Ariz)
W68-01085

OPTIMAL GROUND-WATER MINING,
Desert Research Institute, Nevada Univ., Reno.
For primary bibliographic entry see Field 06A.
For abstract, see .
W68-01110

AVAILABILITY OF GROUND WATER IN THE OAKTON QUADRANGLE AND PART OF THE WOLF ISLAND QUADRANGLE IN JACKSON PURCHASE REGION, KENTUCKY,
U S Geological Survey.
Arnold J. Jansen, Jr.
U S Geol Surv Hydrol Invest Atlas HA-182, 1 sheet, 1968. 1 map, 2 tab.

Descriptors: *Groundwater, *Hydrologic data, *Aquifers, *Water quality, *Water levels, Water wells, Chemical analysis, Hydrogeology, Water table, Water sources, Water yield, Kentucky.
Identifiers: Jackson Purchase, Kentucky, Oakton quadrangle.

Groundwater for domestic, irrigation, and industrial use is abundant in the Oakton quadrangle and the Kentucky part of the Wolf Island Quadrangle in the Mississippi Valley of Kentucky. The principal aquifers are the Eocene sands and the Pleistocene alluvial gravel. The saturated thickness of the alluvial gravel ranges from 32 to 96 ft. Yields may exceed 1,000 gpm where the saturated gravel is thickest. The Eocene sands are 800-1,000 ft thick and dip southwestward about 30 ft per mile. There are 5 water-bearing units in the Eocene, and the major aquifer is near the bottom, a moderately thick sand which may yield 1,400 gpm. The water in the Quaternary alluvium is very hard and generally contains 425-525 ppm dissolved solids; the pH is 7.2-7.9. Iron and manganese may be too high for satisfactory water use. Water from the Eocene is satisfactory for most uses. Dissolved solids range from 70-375 ppm; pH ranges from 6.4-6.8. Iron content is less than 0.3 ppm. A geologic section and a cross section describe the lithology and hydrology of rocks from Cretaceous to Recent. A map scaled 1:24,000, shows availability of groundwater, location of wells, and quality of water. (Knapp-USGS)
W68-01117

AVAILABILITY OF GROUND WATER IN THE PARTS OF THE WICKLIFFE AND WICKLIFFE NW QUADRANGLES IN JACKSON PURCHASE REGION, KENTUCKY,
U. S. Geological Survey.
T. W. Lambert.
U S Geol Surv Hydrol Invest Atlas HA-185, 1 sheet, 1968. 1 fig, 1 map, 1 chart, 6 ref.

Descriptors: *Groundwater, *Hydrologic data, *Aquifers, *Water quality, Water wells, Hydrogeology, Water table, Water sources, Kentucky.
Identifiers: Jackson Purchase area, Wickliffe quadrangle.

Large supplies of surface and groundwater are available in the Wickliffe area, Jackson Purchase region, Kentucky. Only small groundwater withdrawals are now being made, totaling less than 150,000 gpd. Important aquifers are in Paleozoic chert and limestone, Late Cretaceous and early Eocene sands, and Pleistocene gravelly sand. The chert aquifer may be able to yield about 1,500 gpm to wells; Eocene sands yield more than 1,000 gpm from 3 different levels. The water surface is from 330-370 ft msl, highest near the Mississippi River. The saturated thickness of the Quaternary alluvium is 18-64 ft. Quality of the groundwater is generally good, but the Eocene aquifer has water of high iron content which probably is actually caused by well casing corrosion. Water quality is reported in a table giving results of 18 analyses for iron, manganese, and pH. A cross section and geologic column show stratigraphy and hydrologic properties of rocks from Silurian to Recent age. A map, 1:24,000 scale, shows availability of groundwater, location of wells, and quality of water. (Knapp-USGS)
W68-01132

AVAILABILITY OF GROUND WATER IN PARTS OF THE CAIRO AND BARLOW QUADRANGLES IN THE JACKSON PURCHASE REGION, KENTUCKY,
U. S. Geological Survey.
Arnold J. Hansen, Jr.
U S Geol Surv Hydrol Invest Atlas HA-186, 1 sheet, 1968. 2 fig, 1 map, 1 chart, 2 ref.

Descriptors: *Groundwater, *Hydrologic data, *Aquifers, *Water quality, *Water levels, Water wells, Chemical analysis, Hydrogeology, Water table, Water sources, Water yield, Kentucky.

Identifiers: Jackson Purchase, Kentucky, Barlow quadrangle.

Abundant groundwater for domestic, irrigation, and industrial use is available in the Cairo and Barlow quadrangles in the Mississippi Valley, Jackson Purchase, Kentucky. The principal aquifers are Pleistocene alluvial gravels, Pliocene-Pleistocene gravels, and Eocene sands. Other aquifers are in the Paleozoic and Cretaceous rocks. The saturated thickness of the alluvial gravel ranges from less than 10 to 71 ft. Yields to wells may be from several hundred to 1,400 gpm. Wells in the Eocene sand may yield as much as 500 gpm. The municipal well at Barlow yields 280 gpm with a specific capacity of 9.5 gpm per ft. The water level slopes westward. The Cretaceous McNairy Formation may yield domestic supplies to flowing wells. Water in the alluvium has too much iron for most uses, and most of it is also very hard. The Pliocene-Pleistocene gravel yields water which is very hard and contains 150-300 ppm of total dissolved solids. The Eocene water is generally soft and contains 75-150 ppm total dissolved solids; its pH is about 6.5. A table lists iron and pH for 14 samples. Geologic cross sections and a stratigraphic column show stratigraphy and hydrologic properties of rocks. A map, scaled 1:24,000, shows availability of groundwater, location of wells and test holes, and quality of water. (Knapp-USGS)
W68-01134

GEOLOGY AND GROUND-WATER RESOURCES OF THE LOWER BIGHORN VALLEY, MONTANA,
U. S. Geological Survey.
L. J. Hamilton, and Q. F. Paulson.
U S Geol Surv Water-Supply Pap 1876, 39 p, 1968. 7 fig, 1 plate, 6 tab, 19 ref.

Descriptors: *Groundwater, *Water resources, *Geologic investigations, *Aquifers, *Gravels, Saline water, Alkaline water, Saline soils, Data collections, Alluvium, Irrigation, Water yield, Hydrologic properties, Water level fluctuations, Water quality, Montana.
Identifiers: Bighorn Valley, Montana.

The only economic sources of groundwater in large areas of the lower Bighorn Valley, Montana, are 6 terrace gravel deposits 100-200 ft apart in altitude and about 30 ft thick. The bedrock cut by the river is very thick, relatively impermeable Cretaceous shale. In 3 places sandstone aquifers with soft, moderately to highly mineralized water with large amounts of Na are at moderate depths. Groundwater in the alluvium is hard, and in the irrigated lowlands it is highly mineralized where drainage is slow and evapotranspiration is great. Recharge by irrigation water and seepage from irrigation canals help maintain high water levels. Alluvial wells yield up to 100 gpm. Some alluvial aquifers are confined by relatively impermeable surficial silt and clay deposits and have a slight artesian pressure which keeps the water level close to the surface and causes waterlogging and alkali deposition problems. Drainage ditches must be used to prevent waterlogging if any irrigation of higher terraces is attempted. (Knapp-USGS)
W68-01144

SUMMARY OF THE GEOLOGY AND GROUND-WATER RESOURCES OF PITT COUNTY, NORTH CAROLINA,
U S Geological Survey.
Carlton T. Sumsion.
U S Geol Surv Hydrol Invest Atlas HA-291, 1 sheet, 1968. 1 map, 2 fig, 2 ref.

Descriptors: *Groundwater, *Hydrologic data, *Aquifers; *Water quality, *Water levels, Water wells, Water sources, North Carolina, Water yield, Chemical analysis, Hydrogeology.
Identifiers: Pitt County, North Carolina.

Groundwater in Pitt County, North Carolina, occurs in 300-1,200 ft of unconsolidated Lower Cretaceous to post-Miocene sediments that overlie crystalline, non-water bearing rocks. The sediments contain 7 artesian aquifer systems with an average porosity of about 30% , and an unconfined surface aquifer. Aquifers 1 and 2, the lowest, average about 50 ft thick, and yield soft water to municipal wells at Farmville but brackish water east of Greenville. Aquifer 3 is the major aquifer of the county. It averages 125 ft thick, and consists of silts, clays, and coarse sands. It yields soft bicarbonate water to municipal wells at Ayden, Bethel, Farmville, Fountain, Greenville, and Grifton. Chlorides exceed 250 ppm only in the easternmost part of the county. Aquifers 4-6 yield smaller quantities of generally excellent water. Aquifer 7 is unconfined, averages 25 ft thick, consists of fine to medium sands and silt, and yields slightly acidic hard water with large amounts of iron. Pumpage is about 15% of estimated recharge. Industries use municipal supplies and have not contaminated groundwater. A 1:125,000 map shows aquifer characteristics. Cross sections show correlation of aquifers and geologic formations. Tables give aquifer hydrological properties and chemical analysis of waters. (Knapp-USGS)
W68-01147

THE OPTIMUM MANAGEMENT OF GROUND WATER RESOURCES,
California Univ., Los Angeles.
Warren A. Hall, and John A. Dracup.
Proc Int Conf Water For Peace, Pap No. P/521, Washington, D. C., May 1967. 7 p, 25 ref.

Descriptors: *Water management (Applied), Water resources development, *Groundwater basins, Groundwater mining, Groundwater recharge, Arid lands, *Optimization, Simulation analysis, Filtration, Energy, Linear programming, Legal aspects, Institutional constraints, Groundwater movement.

The present concepts of groundwater management in arid regions were presented and expanded to deal more effectively with the problems of economic growth that rely on groundwater. The current management practices of safe yield and groundwater mining were described. It was suggested that groundwater basins could also be used as follows: (1) as reservoirs with low evaporation losses; (2) as transmission systems; (3) as energy resources dependent on storage levels; and (4) as filtration mediums. Optimization techniques such as simulation, parametric linear programming and dynamic programming were suggested as methods of analysis for the integrated systems. Physical problem areas (e.g. land subsidence, sea water intrusion, deterioration in groundwater quality), legal aspects and institutional problems were discussed.
W68-01156

THEORETICAL PREDICTION OF EVAPORATION LOSSES FROM GROUNDWATER,
Unesco College of Engineering, Riyadh, Saudi Arabia.
For primary bibliographic entry see Field 02D.
For abstract, see .
W68-01172

RECLAMATION OF ANCIENT AGRICULTURAL SOILS IN WAHIDI, SOUTH ARABIA,
Empire Cotton Growing Corp., London; Dept., of Agriculture, Federation of South Arabia.
For primary bibliographic entry see Field 03C.
For abstract, see .
W68-01177

U S GEOLOGICAL SURVEY TRACER STUDY AMARGOSA DESERT, NYE COUNTY, NEVADA--PART I: EXPLORATORY DRILLING, TRACER WELL CONSTRUCTION AND TESTING AND PRELIMINARY FINDINGS,
U S Geological Survey.
Richard H. Johnston.
U S Geol Surv open-file rep, 1968. 64 p, 7 fig, 14 tab, 5 ref.

Descriptors: *Drilling, *Tracers, *Carbonate rocks, *Nevada, Stratigraphy.
Identifiers: *Amargosa desert, Exploratory wells, Tracer experiments.

In order to determine the rate of groundwater movement in carbonate rocks and the transport of various nuclides in the water at the Nevada Test Site, a tracer study was made in the Amargosa Desert, Nye County, Nevada. The site is underlain by lake deposits, alluvium, and basalt of Cenozoic age, and at greater depth by carbonate rocks of Paleozoic age. As expected near a major discharge area (a line of springs in this area) the water-level potential is higher in the carbonate rocks than in the alluvium; the head differential is less than 1 ft. Three exploratory holes, 3 holes for tracers, and a sampling hole were drilled at the site to determine aquifer constants in the carbonate rocks, as well as porosity and real velocities of water. Described in Part I are: the results of exploratory drilling, the tracer well construction program, and the results of preliminary hydraulic testing. (Llaverias-USGS)
W68-01248

GROUND-WATER RESOURCES OF WOOD COUNTY, TEXAS,
U S Geological Survey.
M. E. Broom.
Tex Water Develop Board Rep 79, 84 p, Aug 1968. 19 fig, 11 tab, 35 ref.

Descriptors: *Groundwater, *Water wells, *Hydrologic data, *Water quality, *Data collections, Aquifers, Chemical analysis, Water levels, Hydrogeology, Texas, Water table, Observation wells, Subsurface waters, Water yield, Specific capacity, Stream gages, Duration curves, Hydrographs.
Identifiers: *Wood County, Texas, Flow duration.

Groundwater resources, which supply nearly all the water used in Wood County in northeastern Texas, are described. The principal sources are the Tertiary Carrizo-Wilcox and Sparta-Queen City aquifers. The safe perennial yield is about 53,000 acre-ft per yr, of which about 50,000 acre-ft per yr is in the Sparta-Queen City aquifer; the 1965 pumping rate was only about 3,500 ac-ft per yr. About 34 million acre-ft of fresh water is stored in the upper 400 ft of the aquifer. Low pH and high iron content of the water may limit large-scale groundwater development. The occurrence of iron is predictable, so that with careful well construction and pumping, relatively iron-free water can be recovered from both aquifers. Groundwater basic data tables include well description, chemical data, depth to water, and driller's names. Hydrographs and flow-duration curves of the streams in the county are also presented. A geologic map and cross sections, maps showing depth to the aquifers, a map of water levels, graphs showing drawdown-distance-time, diagrams showing iron-bearing zones, and maps showing aquifer thickness are included. (Knapp-USGS)
W68-01250

GEOLOGY AND GROUND WATER RESOURCES OF THE KALISPELL VALLEY, NORTHWESTERN MONTANA,
U. S. Geological Survey, Water Resources Div.
R. L. Konizeski, Alex Brietkrietz, and R. G. McMurtrey.
Mont Bur of Mines and Geology Bull 68, 42 p, July 1968. 34 fig, 5 plate, 6 tab, 34 ref.

Descriptors: *Water resources, *Groundwater, *Aquifers, *Water quality, *Water yield, Hydrographs, Specific capacity, Hydrogeology, Montana, Water levels, Transmissivity.
Identifiers: *Kalispell Valley, Bouguer gravity values.

Principal aquifers and the occurrence, movement, quantity, and quality of groundwater in the Kalispell Valley, northwestern Montana, were studied to provide data for planning optimal water use and development. The valley is a trench-like graben in Precambrian rocks, formed in late Paleocene-Eocene time and partly filled with unconsolidated Tertiary and Quaternary glacial and alluvial materials as thick as 4,800 ft. The aquifers defined are in Precambrian bedrock, deep Pleistocene units under artesian head, 2 shallow artesian aquifers, 3 small perched aquifers, and the water-table aquifer in Recent flood plain deposits. The Precambrian rocks yield adequate quantities of water to stock wells. The Pleistocene artesian aquifers flow as much as 225 gpm and can yield as much as 1,500 gpm when pumped. The flood plain gravels are up to 28 ft thick and yield as much as 2,800 gpm with an average transmissibility of 1,100,000 gpd per ft. Well hydrographs, water-level maps, and geohydrologic cross sections summarize the aquifer data. Maps scaled about 1 in. to 1 mi show geology, Bouguer gravity, piezometric surface of the deep aquifer, perched watertable contours, and contours on the water table during a rise of Flathead Lake. (Knapp-USGS)
W68-01265

GROUND-WATER LEVELS IN NEW MEXICO, 1966,
U. S. Geological Survey.
F. E. Busch, and J. D. Hudson.
N. Mex State Eng Basic Data Rep, 1968. 71 p, 29 fig, 35 tab, 32 ref.

Descriptors: *Groundwater, *New Mexico, *Water levels, *Data collections, *Water level fluctuations, Water wells, Hydrologic data, Water table, Groundwater basins, Observation wells.
Identifiers: *Water level measurements, Periodic observations.

Annual measurement in 1,490 observation wells in New Mexico are tabulated. The wells are in 7 major drainage basins or groups of basins. Water level measurements are used to evaluate the State's water resources and to control the withdrawal of water. Measurements are made in Jan and Feb in irrigation areas. The time of measurement is chosen to be when recovery of water levels from pumping of the previous irrigation season is nearly complete, for the best comparison with measurements of other years. Maps show the water levels and changes in levels. All measurements are given in feet below land-surface datum. Heavy rainfall on Aug 22, 1966 averaged over 4.50 in. and caused heavy property damage as well as heavy recharge. Water levels rose as much as 1 ft in the unconfined High Plains aquifer and up to 13 ft in the artesian wells of the Roswell Basin. Well-data tables give the location of wells, name of owner, formation, 1967 water level, change, highest and lowest levels of record, and period of record. Some artesian levels are also shown graphically. (Knapp-USGS)
W68-01266

GEOLOGY AND WATER RESOURCES OF THE HIBBING AREA, NORTHEASTERN MINNESOTA,
U. S. Geological Survey.
Gerald F. Lindholm.
U. S. Geol. Surv Hydrol Invest Atlas HA-280, 3 sheets, 1968. 6 maps, 6 tab, 9 ref.

Descriptors: *Water resources, *Surface waters, *Groundwater, *Water quality, *Hydrogeology, Aquifers, Streams, Hydrologic data, Water levels, Springs, Water sources, Water yield, Specific capacity, Minnesota.
Identifiers: Hibbing area, Minnesota, Swan River.

Groundwater from wells in glacial drift is the major source of water in the Hibbing area, northeast Minnesota. The larger-capacity wells are in thick sand and gravel deposits in the southern half of the area, where increased water needs can be met by development of channel-fill deposits. In the northern half, limited groundwater supplies occur and the water is very hard, high in dissolved solids, with excessive Fe and Mn. Good water may be obtained from the underlying Precambrian Biwabik Formation but induced recharge of inferior water from the drift, effect of mining operations on ultimate yield, and conflict of interest in development preclude adequate utlimate yields. Large amounts of good surface water are available from the nearby Swan River. Data are presented in maps scaled 1:24,000 showing groundwater quality, use, movement, and availability; geology; and contours on the pre-Pleistocene surface. Geology, water-bearing characteristics and water quality data are tabulated. Graphs show precipitation, Swan River discharge, precipitation, well water level fluctuations with pumping, distance-draw-down curves, and flow duration. Geologic cross-sections show stratigraphic relations of the Precambrian and glacial formations. (Knapp-USGS)
W68-01267

CLASSES OF WATER AND CHARACTER OF WATER RIGHTS AND USES - SECTION 52: THE PRINCIPAL CATEGORIES OF SURFACE AND GROUND WATERS,
For primary bibliographic entry see Field 06E.
For abstract, see .
W68-01291

4C. Effects on Water OF Man6s Non-Water Activities

THE EFFECTS OF VARYING LAND AND WATER USE ON STREAMFLOW REGIMEN,
Wyoming Univ., Laramie.
Paul A. Rechard, and John E. Lane.
Wyoming Univ Water Resources Res Inst Report No 10, 64 p, June 1968. 16 tab, 7 fig, 44 ref, list of WRRI series reports.

Descriptors: *Hydrologic budget, *Urbanization, *Municipal water, *Water rights, *Prior appropriation, *Consumptive use, *Irrigation water, Return flow, Water distribution (Applied), Water utilization, Wyoming, Equitable apportionment.
Identifiers: *Municipal-agricultural water use comparison, *Streamflow regimen, Laramie.

The effects on streamflow regimen of purchase of irrigation water rights by a municipality, converting irrigated land to dry land and transferring the water to a point of use several miles away, were studied. A water budget of the City of Laramie, Wyoming, was made on a daily basis from May 1, 1965, to Sept 30, 1967. All inflows to the system and outflows to the river were monitored. Both an inflow-out-flow study and a Blaney-Criddle analysis were made of agricultural use; return to the stream is estimated to be 20% of agricultural diversion. The city should deplete a purchased appropriation less than agriculture depletes the same flow during the irrigation season. A diversion to municipal use of 75% of the purchased water right precludes any depletion injury to previous downstream appropriations. Water should be returned to the stream with minimum quality deterioration. (Knapp-USGS)
W68-01261

NAVIGABLE WATERS - RIGHTS OF RIPARIAN OWNER HELD NOT TO INCLUDE THE RIGHT TO CONSTRUCT A PERMANENT DEEP WATER DOCK INTO LAKE HURON,
John E. S. Scott.
Wayne State Law Rev, Vol 7, No 3, pp 492-496, Spring 1961. 5 p, 31 ref.

Descriptors: *Michigan, *Docks, *Riparian rights, Damages, Water pollution, Lake Huron, Ownership of beds, Submerged Lands Act, Navigation, Admiralty, Dredging.

This is a Michigan case concerning dock construction on Lake Huron. Obrecht v National Gypsum Co, 361 Mich 399, 105 N W 2d 143 (1960). Riparian owners brought suit to enjoin an adjoining riparian from constructing a dock into Lake Huron. The court held against the defendant, stating that while it recognizes the common law right to 'wharf out', the public right in the waters and submerged lands of the Great Lakes, held in trust by the state, is supreme against the defendant's asserted riparian rights. However, the defendant was not required to remove the dock because of 'great property loss,' and was only required to bear the damages of adjoining riparians. The article discusses the general doctrine, concerning the right to wharf out and concludes that the case is consistent with Michigan law. (Crabtree-Fla)
W68-01329

LIABILITY FOR DIVERSION OF SURFACE WATERS.
Ohio State L. J., Vol 22, No. 1, pp 241-243, Winter 1961 3 p, 20 ref.

Descriptors: *Natural flow doctrine, *Ohio, *Reasonable use, Civil law, *Repulsion (Legal aspects), Municipal water, Riparian land, Grading, Surface drainage, Surface runoff, Damages, Relative rights, Alteration of flow.

The Ohio case of Johnson v Goodview Homes -1, Inc., 82 Ohio L Abs. 526, 167 N. E. 2d 132 (C. P. 1960), concerned the diversion of surface water by an upstream owner. The corporate defendant, while grading, filled a gully, terraced the land and installed drainage pipes to carry surface water from the front of its property to the rear. As a result, the flow of surface water was increased and accelerated onto the land of plaintiff, the lower adjoining owner, causing damage to his basement and house foundation. The court ruled that defendant's actions constituted a trespass, enjoined defendant from further piping, and awarded damages. The article discusses the 3 general rules as to diffused surface water, the common enemy doctrine, the natural flow doctrine, and the reasonable use doctrine. Ohio apparently is in a state of flux, but generally applies the natural flow rule. However, there appears to be different rules applied to municipal owners, and to upper owners as opposed to lower owners. The article indicates that the upper owner is bound by natural flow while the lower owner is entitled to reasonable use. (Crabtree-Fla)
W68-01330

REAL PROPERTY - WATERS AND WATERCOURCES - LIABILITY FOR DAMAGE CAUSED BY OBSTRUCTION OF PERCOLATING WATERS.
Iowa L Rev, Vol 46, No 3, pp 694-700, Spring 1961. 7 p, 37 ref.

Descriptors: Underground streams, Drainage water, Reasonable use, *Subsurface drainage, *Percolating water, Natural flow doctrine, North Carolina, Riparian rights, Remedies, Seepage, Surface-groundwater relationships, *Obstruction to flow, Groundwater barriers.

This article concerns Jones v Home Bldg and Loan Ass'n, 114 S E 2d (N C 1960). Defendant corporation was the lower owner who constructed a building on land adjoining plaintiff's higher ground. Thereafter water began to seep through plaintiff's basement floor. Defendant had been aware of the water problem during construction. Plaintiff sued for damages based on the willful obstruction of a known underground stream. On appeal from a verdit for plaintiff, held reversed. Plaintiff did not prove his allegations, but his evidence did show a negligent failure to provide for adequate drainage of known percolating waters, and the case must be retried on this theory. The article then discusses the English and American rules in this area. It argues that proper distinction cannot be made between percolating water and underground streams. It further argues that the rule as to underground

waters should be the same as that applicable to surface waters, and that the proper action here is one based on realty, rather than in tort. (Crabtree-Fla)
W68-01334

URBAN DRAINAGE: ASPECTS OF PUBLIC AND PRIVATE LIABILITY,
Maxine Kurtz.
Dicta, Vol 39, No 4, pp 197-210, July-Aug 1962. 14 p, 78 ref.

Descriptors: Urbanization, *Surface drainage, Civil law, *Remedies, Repulsion (Legal aspects), Reasonable use, *Cities, Drainage systems, Judicial decisions.

The article presents the basic doctrines and trends relating to both public and private liability for the interference with drainage in a municipality. Civil law doctrine prohibits both upper and lower proprietors from altering natural drainage conditions. It has been modified to allow alteration so long as additional harm does not result. The common law rule (common enemy) allows all but unnecessary or wanton repulsion of surface water. Several states have adopted a reasonable use rule. Urban-rural distinctions are recognized under each of these four general rules. The potential theories of liability against municipal corporations are numerous: negligent planning or construction; negligent maintenance; nonfeasance by failure to correct known obstruction by roads; eminent domain; nuisance and other absolute liabilities. Urban growth necessitates that relative rights and responsibilities of cities and property owners be set down in systematic fashion. (MacMillan-Fla)
W68-01335

IMPLIED COVENANT TO PROTECT LEASED PREMISES FROM DRAINAGE WHERE LESSEE IS RESPONSIBLE FOR DRAINAGE,
Charles Ray Davis.
Miss L J, Vol 35, No 3, pp 280-295, March 1964. 16 p, 73 ref.

Descriptors: *Natural gas, *Subsurface drainage, *Leases, Judicial decisions, *Mississippi, Oil wells, Exploitation, Oil reservoirs.
Identifiers: Liability.

Recent court decisions in Mississippi have clarified the law with respect to the effect of drainage caused by a lessee (rather than a third part) on the ordinary rules governing the implied covenant to protect against drainage in an oil and gas lease. A common lessee of two adjoining tracts is not liable for all drainage from one tract through wells on an adjoining tract. The Millette cases established standards of bad faith and substantial drainage. The test of the dissent that the duty of the lessee be measured by the standard of the prudent operator in the absence of fraud is, in the author's view, less ambiguous and therefore preferable. (MacMillan-Fla)
W68-01336

HIGHWAYS - FLOOD DAMAGE - PROPOSED MODIFICATION OF COMMON ENEMY RULE,
John L. O'Brien.
Wis L Rev, Vol 1963, No 4, pp 649-660, July 1963. 12 p, 43 ref.

Descriptors: *Natural flow doctrine, Wisconsin, Civil law, *Road construction, Highways, *Surface runoff, *Repulsion (Legal aspects), Flood damage, Legislation, Judicial decisions, Riparian land, Eminent domain, Reasonable use, Right-of-way.
Identifiers: Inverse condemnation.

This article deals with diffuse surface water and its effect on, as well as by, highway construction. Wisconsin has handled the problem by statute. Before modifying legislation, the state applied the common enemy doctrine. The article considers proposed legislation which will be in favor of highway agencies. This legislation will place an affirmative duty of care on landowners. It is somewhat obscure as to what will constitute inverse condemnation and provides remedial action only after damage has been done. Taking previous legislation in this area along with proposed Statute 88.87, the effect of the common enemy doctrine should be avoided in Wisconsin. The article gives an argument for injunctive relief in this area before damage, concluding that this would be the best way to avoid damage, and to protect the interests of the landowners and highway agencies. (Crabtree-Fla)
W68-01339

4D. Watershed Protection

EFFECT OF GRAZING ON INFILTRATION IN A WESTERN WATERSHED,
Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colorado.
J. R. Thompson.
J of Soil and Water Conserv, Vol 23, No 2, pp 63-65, March-April 1968. 3 p, 4 fig, 1 tab.

Descriptors: *Grazing, *Infiltration, Watersheds (Basins), Stocking, Erosion, Soil types, *Infiltrometers, Runoff.
Identifiers: Plots.

Twelve infiltrometer plots, stratified by major soil types, were located in each of eight watersheds to test the effects of livestock exclusion on infiltration and erosion of Badger Wash in western Colorado. The four soil types were derived from shale, sandstone, a mixture of shale and sandstone, and alluvium. Artificial rainfall was applied to 2.5-square-foot plots at the rates of 5 inches per hour. Runoff from the plots and amount and intensity of applied rainfall were measured with the Rocky Mountain infiltrometer. Average infiltration rates for dry soils were lower in 1963 than in 1953-1954 or 1958 on both grazed and ungrazed plots. In 1963 infiltration declined to a point lower than the pretreatment level for both grazed and ungrazed plots. In 1963 an apparently consistent increase in erosion accompanied the decrease infiltration. Penetrometer measurements and bulk density values indicated a slight improvment in surface soil conditions between 1958 and 1963 without respect to grazing treatment. Ground cover on grazed watersheds decreased significantly from 29% in 1953 to 20% in 1963. A possible explanation of decreases is discussed. (Blecker-Ariz)
W68-01105

HYDROLOGIC DATA FOR EXPERIMENTAL AGRICULTURAL WATERSHEDS IN THE UNITED STATES, 1962,
U S Dept of Agriculture, Agricultural Research Serv.
Harold W. Hobbs.
U S Dep of Agr, Agr Res Serv Misc Publication No 1070, 447 p, June 1968. 1 map, 4 tab, 114 ref.

Descriptors: *Watersheds (Basins), *Agricultural watersheds, *Data collections, *Hydrographs, *Hydrologic data, Precipitation (Atmospheric), Temperature, Storm runoff, Isohyets, Floods, Drainage, Instrumentation, Land management, Rainfall intensity.
Identifiers: Experimental Agricultural Watershed program, Runoff intensity.

Selected hydrologic data for yr 1962 are presented. The data include monthly precipitation and runoff for 164 watersheds, annual maximum discharges and annual maximum volumes of runoff for 155 of the watersheds for time intervals of 1, 2, 6, and 12 hr and for 1, 2, and 8 days, daily precipitation and discharge and daily air temperature on 51 watersheds, and detailed information for 1 or more selected storm events for 136 watersheds. Information on storm events includes tabular data for 30-day rainfall and runoff prior to the events, data on rainfall and runoff intensity, accumulated depths of rainfall and runoff, description of watershed conditions, hydrographs, rainfall histograms, watershed maps, and isohyetal maps. Descriptions of watershed physical characteristics, instrumentation, maps, land management, and recommended area of application of results are also given for newly established watersheds. Descriptions of old watersheds are revised. (Knapp-USGS)
W68-01121

CRIB DAMS FOR CONTROL OF SEDIMENT AND STREAMBED EROSION AND THEIR SUITABILITY FOR CONDITIONS IN PAKISTAN,
Pakistan Forest Institute, Peshawar.
For primary bibliographic entry see Field 08D.
For abstract, see .
W68-01179

MULTIPLE LAND USE MANAGEMENT,
For primary bibliographic entry see Field 06B.
For abstract, see .
W68-01319

RELATIONSHIPS BETWEEN WATER AND OTHER PROPERTY RIGHTS AND SMALL WATERSHED DEVELOPMENT IN THE EASTERN STATES,
Harold H. Ellis.
In Economics of Watershed Planning, pp 262-275, Iowa State University Press, Ames, 1961. 13 p, 51 ref.

Descriptors: *Watershed management, *Legislation, *Dams, Reservoirs, Dam construction, Reasonable use, Natural flow doctrine, Artificial watercourses, Natural streams, Condemnation, Condemnation value, Water storage, Regulated flow, Water utilization, Water law, Water permits, Preferences (Water rights), Administrative agencies.

Attention is focused on Public Law 566 projects which are a large part of watershed development in eastern states. The author begins with court made definitions of water rights. The right to use water for artificial reasons depends on either the natural flow or reasonable use of doctrines. Dam construction on a watercourse is the next topic. Emphasis is placed on the totality of factors to be considered. Attention is turned to the use of condemnation powers. There are basic rules for the determination of a fair compensation. The author next discusses legislation in the area of dams and impoundments. Recent legislation allows for storage of water during high flow seasons for use during low flow seasons. The author raises some problems surrounding the statutes. Minimum streamflows are considered. The author also raises non-riparian use and the factors involved permanent non-riparian use. Preference questions are raised and a list of preferences given, followed by a discussion of permits. The author closes with mention of the probable impact of the watershed districts on the systems of water rights and the functions of state agencies. (Breuel-Fla)
W68-01325

STATE DISTRICT LAWS AS THEY AFFECT WATERSHED DEVELOPMENT,
Robert C. Otte.
In Economics of Watershed Planning, pp 277-292, Iowa State University Press, Ames, 1961. 15 p, 3 tab, 21 ref.

Descriptors: *Legislation, *Watershed management, *Local government, *Water districts, Drainage districts, Irrigation districts, Soil conservation, State governments, Flood control, Water law.

Because of the inadequacy of the market place, government has played an increasing role in the development of small watershed projects. One result is the resource protection and development district. The author interjects a section on the sponsors of Public Law 566 Projects complete with a table. The bulk of the study is devoted to the various

types of districts. A table is provided. The districts mentioned are soil conservation, multi-purpose, flood-control, drainage, irrigation and other single-purpose districts. A section follows on the part played by counties and municipalities with the approval of states. Dependent districts are also discussed with a table. The final substantive section is devoted to the responses made by state legislatures to Public Law 566. The conclusion is that local government is intrusted with a substantial amount of watershed development. (Breuel-Fla)
W68-01326

MODEL WATERSHED DISTRICT ACT,
Milton S. Heath, Jr.
In Economics of Watershed Planning, pp 295-310, Iowa State University Press, Ames, 1961. 15 p, 1 ref.

Descriptors: *Legislation, *Watershed management, *Water districts, Water law, Administrative agencies, Water rights, Local governments, Water policy.

The purpose of this chapter is to present model legislation. The act has five major provisions, according to its author: (1) districts created by landowner's petitions, (2) district functions to include most functions possible, and power to enter contracts, (3) administration via trustees, (4) financing via direct assessments, (5) the minimum of state supervision. The act also makes several provisions in the area of water rights. First, the district itself takes title to property in the State's name to avoid problems with changes in the law. Second, the act does not change existing water rights or expand district use powers. Third, the state agency must ratify district work plans. The author also warns that any use of the Model Act should be consistent with the language and procedures of the law in each jurisdiction. (Breuel-Fla)
W68-01327

ECONOMIC EVALUATION OF THE SMALL WATERSHED PROGRAM,
American Farm Economic Assoc, Menaska, Wis.
Morris Weinberger, and Robert C. Otte.
Journal of Farm Economics, Vol 39, No 5, Dec 1957, pp 1256-1268, 12 p, 12 ref.

Descriptors: *Watershed Protect. and Flood Prev. Act, *Evaluation, Soil conservation, *Economic efficiency, *Watershed management, History, Legislation, Federal project policy, Project purposes, Demonstration watersheds, Flood protection, Land management, Small watersheds, Water supply, Structural analysis, Planning.

The focus of this article is on Public Law 566, as amended by Public Law 1018, commonly known as the Watershed Protection and Flood Prevention Act. Earlier legislation included the creation of the Soil Conservation Service in 1935 and the Flood Control Act of 1936, as well as a 1953 pilot program. A watershed project under Public Law 566 must be requested by local organizations. Requirements for local organizations are listed. Economic analysis of watershed programs is provided for by Congress, the President, and others. Economic analyses are being conducted on numerous pilot projects, including surveys by the Soil Conservation Service. Because of the rapid expansion of these projects, it will be necessary to have data on economic matters, resulting from research efforts of economists and physical scientists. Structural and land treatment measures are crucial to these projects. Reduction of flood damages evaluation is discussed. Another problem area is the evaluation of measures for stabilizing gullies and waterways. Water supply is generally not included as a Public Law 566 purpose. Other subjects briefly covered are secondary project effects, maximization of net benefits, and the future role of economic evaluation.
W68-01378

05. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification OF Pollutants

AUTOMATED WATER QUALITY MONITORING,
Fed. Water Pollut. Contr. Admin., Cincinnati, Ohio.
Dwight G. Ballinger.
Environ Sci and Technol, Vol 2, No 8, pp 606-610, Aug 1968. 5 p, 7 photo, 2 tab, 7 ref.

Descriptors: *Water quality, *Monitoring, *Data transmission, *Measurement, *Instrumentation, Control systems, Data collections, Regulation, Telemetry, Electronic equipment, Automation, Sampling, Colorimetry.
Identifiers: *Automatic monitoring equipment.

Continuous monitoring of water quality in streams is desirable because significant changes occur often and abruptly. Changes in flow and unpredictable industrial discharges or spills may alter concentrations of constituents of interest to water users. Manuel sampling is impractical, so a variety of automatic samplers has been developed. Telemetry, alarm systems, and the use of monitors, as part of the waste-control process, are essential parts of the monitoring concept. Sensors must be rugged, automatically cleaned, protected from damage and fouling, and accessible for repair. Electrical and colorimetric sensors measure pH, conductance, chlorides, dissolved oxygen, temperature, and turbidity. FWPCA performance specifications and lists of producers of monitoring equipment are included. (Knapp-USGS)
W68-01049

REVIEW OF THE METABOLISM AND DECOMPOSITION OF DIQUAT AND PARAQUAT,
Auburn Univ.
H. H. Funderburk, Jr., and G. A. Bozarth.
Agricultural and Food Chemistry, Vol 15, No 4, pp 563-567, July/August 1967. 5 p, 7 fig, 3 tab, 46 ref.

Descriptors: *Reviews, *Herbicides, *Diquat, *Paraquat, *Metabolism, *Decomposition, Absorption, Adsorption, Soil analysis, Aquatic plants, Translocation, Microorganisms, Persistence, Fish.
Identifiers: *Photodecomposition, Free radical.

The absorption, translocation, and distribution patterns for diquat and paraquat are similar. In most cases these herbicides will move in an acropetal direction, but basipetal movement will occur only under certain conditions. Diquat and paraquat are relatively stable compounds in higher plants but both are degraded by soil microorganisms. Degradation of both compounds occurs rather rapidly in the presence of ultraviolet light, and a proposed pathway for the degradation of paraquat is included. Persistence studies indicated that paraquat is more persistent than diquat. (Daly-Auburn)
W68-01275

PHOTOCHEMICAL DECOMPOSITION OF DIQUAT AND PARAQUAT,
Auburn Univ.
H. H. Funderburk, Jr., N. S. Negi, and J. M. Lawrence.
Weeds, Vol 14, No 3, pp 240-243, July 1966. 4 p, 5 fig, 2 tab, 10 ref.

Descriptors: *Herbicides, *Diquat, *Paraquat, *Ultraviolet radiation, Adsorption, Soils, Water, Radioisotopes.
Identifiers: *Dipyridyls, Autoradiography, *Photochemical degradation.

The effect of UV light (240-260 millimicron range) on diquat and paraquat was studied. Both dipyridyls were very stable in dark but were altered rapidly in the presence of UV light. Radioassay data collected from planchets containing solidified diquat or paraquat indicated a loss of more than 50% of the C-14 from both compounds after 48 hr and more than 75% after 96 hr. When radioactive aqueous solutions were placed under UV lights, little change in the radioactivity occurred during an 8-day period as determined by liquid scintillation. When the concentration of diquat or paraquat in these solutions was determined by chemical analysis, degradation of the original molecule was observed. Information obtained by autoradiography of chromatograms, spotted with radioactive aqueous solutions exposed to UV light, indicated that two or more C-14 containing degradation products were formed from both diquat and paraquat. Cochromatography indicated that one degradation product from paraquat was 1-methyl-4-carboxypyridinium ion. (Daly-Auburn)
W68-01276

METABOLISM OF FLUOMETURON BY SEVERAL BIOLOGICAL SYSTEMS,
Auburn Univ.
H. H. Funderburk, Jr., R. L. Rogers, and R. Rodriquez-Kabana.
VI International Congress of Plant Protection Proceedings, Vol 9, pp 413-414, 1967. 2 p.

Descriptors: *Fluometuron, *Herbicides, *Metabolism, Soil, Resistance.

The fate of C-14-labeled fluometuron in soil and in higher plants was studied under controlled conditions. Thirty days after a Norfolk sandy loam soil was treated with 50 ppm radioactive fluometuron, it was extracted with acetone, and the extract was spotted on prepared thin layer silica gel G plates. The spotted plates were developed and autoradiographed, revealing several labeled metabolites which were identified by comparing their Rf values with the Rf values of nonlabeled possible metabolites. The mono-methylated, de-methylated, and aniline derivatives were identified. The metabolism was studied in cotton and cucumber in an attempt to determine the basis of the difference in susceptibility exhibited by thes two species. A fourth unidentified metabolite was found in cotton. Metabolism appeared more rapid in cotton than in cucumber. The resistance of cotton may be due to its ability to rapidly metabolize fluometuron to less toxic metabolites. (Daly-Auburn)
W68-01281

5B. Sources of Pollution

ANALYZING STEAM ELECTRIC POWER PLANT DISCHARGES,
Vanderbilt Univ., Nashville, Tenn. and Johns Hopkins Univ., Baltimore, Md.
John Eric Edinger, and John C. Geyer.
ASCE Proc, J San Eng Div., Vol 94, No. SA4, Pap 6064, pp 611-623, Aug 1968. 12 p, 5 fig, 2 tab, 4 ref.

Descriptors: *Cooling water, *Thermal pollution, *Thermodynamics, *Path of pollutants, Heated water, Thermodynamic behavior, Thermal powerplants, Temperature, Estuaries.
Identifiers: *Temperature distribution, *Waste heat, Thermoelectric power generation, Case study.

Temperature distribution resulting from the advection, dispersion, and cooling of water from a steam electric power plant condenser is analyzed for a station located on a peninsula and discharging waste heat near the midpoint of a small narrow estuary. A theoretical temperature-distribution equation is used to predict the mean monthly temperatures within a mile of the discharge point for various hot water discharges. Temperatures are related to an equilibrium temperature determined by meterological conditions. A case study indicates that temperature gradients are steep enough near a

large heat discharge to allow the use of simplified, receiving waterbody characteristics to derive boundary value solutions. (Knapp-USGS)
W68-01026

WASTE PRODUCT USE HELPS PAPER INDUSTRY CONTROL POLLUTION,
Institute of Paper Chemistry, Appleton, Wis.
Irwin A. Pearl.
Environ Sci and Technol, Vol 2, No 9, pp 676-681, Sept. 1968. 6 p, 4 fig, 1 photo.

Descriptors: *Pulp wastes, *Sulfite liquors, *Pollution abatement, Waste disposal, Water pllution sources, Pulp and paper industry, Ligins, Carbohydrates.
Identifiers: *Waste utilization.

The history of research and development on the use of the effluent, or spent sulfite liquor, from the sulfite pulping process in paper manufacture is reviewed. Sulfite liquor is a pollutant when discharged into streams, yet it is a valuable raw material for the chemical industry. As the liquor leaves the digester it contains 10% solids, of which 50-60% is calcium lignosulfonate and 25-30% is carbohydrates. About 2.5 million tons are made in the U. S. in a year. The cost of building facilities to use sulfite liquor can be as high as the original cost of a paper mill. Raw liquor may be used in drilling mud, in cattle-feed pellets, and as road binder. Lignosulfonates are also used as dispersants for carbon black in rubber, as raw materials for dyestuff and pesticide manufacture, for ore flotation, and as cement additives. Lignosulfonates complex with metals and may also be used in protein removal in waste disposal. The chemical industry uses spent liquor as a raw material for vanillin, acetic acid, turpentine, dimethyl sulfoxide, and various aromatics. (Knapp-USGS)
W68-01255

FACTORS AFFECTING PERSISTENCE AND INACTIVATION OF DIQUAT AND PARAQUAT,
Auburn Univ, Dept. of Botany and Plant Pathology.
G. E. Coats, H. H. Funderburk, Jr., and J. M. Lawrence.
Weed Research, Vol 6, No 1, pp 58-66, March 1966. 11 p, 6 fig, 1 tab, 16 ref.

Descriptors: *Herbicides, *Diquat, *Paraquat, *Persistence, Leaching, Volatility, Absorption, Translocation, Ultraviolet radiation.
Identifiers: Inactivation, Soil adsorption.

The adsorption of diquat cation was found to be 0.3, 2.0-2.5 and 80-100 mg/g on a sandy loam soil, Grade Hydrite 10 Georgia kaolinite and National Standard Bentonite, respectively. Bentonite (113 lb/surface ac) applied to plastic pools previously treated with 1 ppm paraquat reduced the concentration of paraquat to less than 0.05 ppm within 24 hr of application. Only bentonite appeared to hold either diquat or paraquat in a form unavailable to wheat. Appreciable uptake by wheat from soil treated with diquat or paraquat (16 lb/ac pre-emergence) occurred only in soil or sand in which the herbicide leached below the 0.5 in. zone. A 12 hr dark period following foliage application did not appear to enhance movement of either herbicide in wheat. Loss of radioactivity was observed when diquat or paraquat was exposed to ultraviolet light (2537 Angstroms). (Daly-Auburn)
W68-01274

INTERACTION OF DIPYRIDYLIUM HERBICIDES AND SOIL MICROORGANISMS,
Auburn Univ.
Jiu-sherng Yang, H. H. Funderburk, Jr., and E. A. Curl.
Abstracts of Weed Science Society of America, p 38, February 1968. 1 p.

Descriptors: *Herbicides, *Diquat, *Paraquat, Soil microorganisms, *Yeasts, Metabolism.

Several species of common soil microorganisms were isolated from soil samples and were grown in a C-14-diquat liquid medium. After two weeks, aliquots were electrophoresed, autoradiographed, and degradation products observed. The soil yeast, Lipomyces starkeyi, was studied to determine the effect of time on the amount and types of degradation products of diquat and paraquat. Autoradiographs showed three degradation products from diquat and two from paraquat. This degradation was shown to be enxymatic. Diquat did not affect respiration nor was it a carbon source for the resting cells. (Daly-Auburn)
W68-01282

5C. Effects of Pollution

RESISTANCE OF TEXAS SALT - AND FRESH-WATER - MARSH FISHES TO HEAT DEATH AT VARIOUS SALINITIES,
Arkansas Univ., Fayetteville.
Kirk Strawn, and James E. Dunn.
Texas J of Sci, Vol 19, No 1, pp 57-76, April 1967. 20 p, 7 tab, 3 fig, 17 ref.

Descriptors: *Heat resistance, Salinity, *Salt marshes, Texas, *Killifishes, Brackish water, Submerged plants, Tidal marshes, Dissolved solids, Thermal stratification, Acclimatization.
Identifiers: *Heat death, Heat shock, Survival, Response-surface diagrams.

Heat resistance and effects of various salinities were studied on 10 species of fishes living in or near the salt marshes of the Texas coast utilizing response surface diagrams. Each species reacted differently to the combined stresses of salinity and high temperatures. Some salt in the water afforded protection from heat shock. Resistance to heat in decreasing order was as follows: Cyprinodon variegatus; F. pulvereus; A. xenica; F. similis; and F. grandis. Those four species least resistant were associated with submerged vegetation. As temperature decreased optimum salinities for survival decreased for freshwater fishes and increased for saltmarsh fishes.
W68-01073

MANIPULATION OF RESERVOIR WATER FOR IMPROVED QUALITY AND FISH POPULATION RESPONSE.
Wisconsin Natural Resources Department.

Wis Natur Resources Dep Water Resource Res Sect (Proj Rep), 6 p, (1968) 3 fig.

Descriptors: *Eutrophication, *Fish management, *Oxygen requirements, *Aeration, *Water circulation, Thermal stratification, Fish stocking, Fishkill, Anaerobic conditions, Bubbles.
Identifiers: Artificial lake-water circulation.

A project was undertaken to test the effect of several water management techniques on the water quality and fish populations in artificial lakes and their discharge waters. Two small lakes in steep-sided wooded valleys in Governor Dodge State Park in SW Wisconsin were studied. During summer, algae are a nuisance, surface temperatures are too high, nutrient concentrations are too high, and dissolved oxygen is absent in the bottom layer. In winter, the oxygen level under ice is critically low for fish. Bottom water discharge and air-gun induced circulation were studied as means of alleviating the nutrient and stratification problems. Preliminary results were good. In the circulation program, severe stratification was broken down, temperatures were reduced 5-10 deg, dissolved oxygen was restored at the bottom, water clarity was improved, nutrient concentrations were lowered, snails populated the bottom, and complete freeze-over was prevented. In the bottom-discharge program, water was aerated in the outlet works and downstream water quality was greatly improved. (Knapp-USGS)
W68-01143

EUTROPHICATION IS BEGINNING IN LAKE MICHIGAN,
Federal Water Pollution Control Admin.
A. F. Bartsch.
Water and Waste Eng, Vol 5, No 9, pp 84-87, Sept 1968. 4 p, 3 fig, 1 tab, 3 ref.

Descriptors: *Eutrophication, *Lake Michigan, Algae, Nuisance algae, Plankton, Benthic fauna, Sludge worms, Bloodworms, Water pollution.
Identifiers: Accelerated eutrophication.

A study of the physical, chemical, and biological status of Lake Michigan reveals some early symptoms of accelerated eutrophication. In the offshore areas, two changes in species composition of Zooplankton were seen. Bosmia longirostris replaced B. coregoni, and Diaptomus oregonenis has appeared. Bottom-dwelling animal populations have increased markedly. Total dissolved solids increased 30 mg per L in the last ninety years, sulfate 13 mg per L, and chloride 6 mg per L. Between 1955 and 1966, oxygen content decreased slightly. In the inshore areas, changes are drastic. Attached and floating algae, including large growths of Cladophora, are frequently at nuisance levels. At Green Bay, phosphate concentration varies from 0.07-0.6 mg per L, and in Milwaukee harbor it averages 0.44 mg per L and is sometimes as high 1.4 mg per L. A shift of bottom populations to dense concentrations of pollution-tolerant species such as bloodworms and sludge worms has occurred. Lake Michigan's retention of nitrogen is 81% and of phosphate, 95%, so the problem will not be solved quickly by eliminating input. Immediate control of nutrient input is, however, necessary to prevent further deterioration. (Knapp-USGS)
W68-01244

WATER QUALITY DEGRADATION BY WOOD BARK POLLUTANTS,
Maine Univ., Water Resources Center, Orono, Maine.
Otis J. Sproul, and Clifford A. Sharpe.
Maine Univ., Water Res Center Pub No 5, 53 p, June 1968. 19 fig, 6 tab, 10 ref.

Descriptors: *Water pollution, *Wood wastes, *Bark, *Lignins, *Biochemical oxygen demand, Leaching, Runoff, Groundwater, Cellulose, Hydrogen ion concentration, Toxicity.
Identifiers: *Tannins, Sugars.

The leaching of wood bark was studied in the laboratory to determine its effect upon water quality. Significant water quality degradation results from materials leached from woodbark stockpiles on land or in watercourses. This degradation is from organic and inorganic materials which cause BOD, color, odor, COD, alkalinity, and acidity and increase the solids in the water. Softwood bark leachings from simulated 'dry' land stockpiles had color of up to 1000 units, BOD up to 1200 mg/l and a threshold odor number of 500 at the end of 55 days. Hardwood bark leachings under similar conditions were degraded to a lesser extent except for a higher color. Storage under higher temperatures generally decreased the extent of water contamination. Benthal bark deposits created oxygen demands of about 0.6 to 0.8 pounds per day per ton of dry bark. BOD values within the bark benthal deposit reached 17,700 mg/l. Color of the overlying water reached as high as 6,000 units for the softwood bark. Hardwood barks gave colors as high as 1,000 units. When stockpiled on land woodbark should be placed over impervious material and surrounded by impervious berms so that rainwater moving through the pile cannot carry the pollutional materials into watercourses. (Knapp-USGS)
W68-01269

THE GREAT LAKES WATER RESOURCE,
H. W. Poston, and C. R. Ownbey.
American Water Works Ass'n J, Vol 60, No 1, pp 15-20, Jan 1968. 6 p, 4 ref.

Descriptors: *Great Lakes, *Federal project policy, *Tennessee Valley Authority Project, Administrative agencies, Federal jurisdiction, State jurisdiction, Political aspects, Eutrophication, Oxygen demand, Chemcontrol.
Identifiers: Canada, Province of Ontario.

The problems of eutrophication, increase of chemicals and oxygen depletion are discussed. Measures presently being taken are presented, including federal grants. Legally, however, the judicial process has been inadequate to resolve the problems created by the conflicting interests for the use of the water. While it is agreed that the Great Lakes belong to all the people of the United States and Canada, the problem is who should be the custodian of these waters. A board of directors, similar to that governing the Tennessee Valley Authority is proposed. The representation of the states bordering on the Great Lakes, the Province of Ontario, and the governments of the United States and Canada is discussed. (Storace-Fla)
W68-01305

5D. Waste Treatment Processes

HOW TO OPERATE 'PACKAGE' WASTEWATER TREATMENT PLANTS,
Tennessee Department of Public Health.
John W. Saucier.
Amer City, vol 83, no. 9, pp 92-97, Sept. 1968. 6 p, 5 photo, 2 tab, 2 chart.

Descriptors: *Waste water treatment, *Sewage treatment, *Aerobic treatment, *Tertiary treatment, Aeration, Industrial wastes, Municipal wastes, Oxidation, Chlorination.
Identifiers: *Extended aeration process, *Prefabricated waste-treatment plants.

Small, factory produced extended-aeration wastewater treatment plants that will provide primary, secondary, and tertiary treatment of about 50,000 gpd are available. Such plants have been in successful use in some parts of the country for several years. They usually serve schools, motels, shopping centers, apartment buildings, offices, camps, trailer parks, factories, or small subdivisions. Their principles of operation and proper operating techniques are described. Laboratory tests for dissolved oxygen, settleable solids, chlorine residual, and pH are given. A chart of daily operation and maintenance procedure is included. (Knapp-USGS)
W68-01020

WATER CONSERVATION BY RECLAMATION AND RECHARGE,
Dept. of Public Works, Nassau County, N. Y.; Burns and Roe, Inc., Oradell, N. J.
John H. Peters, and John L. Rose.
ASCE Proc, J San Eng Div, Vol 94, No 6065, pp 625-639, Aug 1968. 15 p, 8 fig, 3 tab, 4 ref.

Descriptors: *Tertiary treatment, *Water reuse, *Groundwater recharge, *Sanitary engineering, *Water resources development, Pilot plants, Municipal wastes, New York, Groundwater barriers, Saline water intrusion, Reclaimed water.
Identifiers: *Water reclamation, Nassau County, Long Island.

Because the only economical source of water for Nassau County, Long Island, New York, is groundwater and the withdrawal rate may exceed recharge by 1977, a study was made of the feasibility and desirability of returning treated wastewater to the ground. Total pumpage was 145 mgd in 1960 and is predicted to be 298 mgd in the yr 2010. The amount pumped and not recharged was 62 mgd in 1960 and is predicted to reach 239 mgd in 2010. Natural recharge is estimated to be 181 mgd and safe yield 154 mgd. A line of recharge wells across southern Nassau County would form a barrier to salt-water intrusion until the draft projected for 1987 is reached. The additional direct injection of reclaimed water in the center of the county would meet a projected deficiency of 85 mgd in 2010. Processes for tertiary treatment are discussed and the test injection facility of Nassau County is described. Unit costs for tertiary treatment are tabulated and compared with costs of development of new surface supplies; it is found that reclamation is usually cheaper in plants reclaiming over 100 mgd. Reclamation and recharge are shown to be technically feasible on a pilot-plant scale. (Knapp-USGS)
W68-01048

PILOT PLANT STUDIES ON THE ANAEROBIC TREATMENT OF TANNERY EFFLUENTS,
Georgia Institute of Technology, Atlanta.
William E. Gates, and Shun-Dar Lin.
J Amer Leather Chemists Assoc, Vol 61, No 10, pp 516-535, Oct 1966. 20 p, 13 fig, 2 tab, 11 ref.

Descriptors: *Sewage treatment, *Anaerobic digestion, *Solids contact process, *Sludge digestion, *Industrial wastes, Activated sludge, Aeration, Effluents, Lagoons.
Identifiers: *Tannery waste treatment.

A laboratory study was conducted on the anaerobic fermentation treatment of raw tannery effluents. An attempt was made to control the usual odor problems of anaerobic processes by maintaining an oxygenated surface layer in reactors divided by baffles into anaerobic and aerated sections. Both an anaerobic lagoon and an anaerobic contact process reactor were able to provide suitable treatment of the tannery wastewaters investigated. Additional work should be done on solids separation in the contact process. The performance of both processes was satisfactory in removal of BOD and COD to limits acceptable for discharge into streams of suitable capacity. (Knapp-USGS)
W68-01125

BALAS ALGORITHM FOR ZONED UNIFORM TREATMENT,
Johns Hopkins Univ., Baltimore, Md.
Jon C. Liebman, and David H. Marks.
Proc Amer Soc Civil Eng, Vol 94, No. SA 4, pp 585-593, Aug 1968. 9 p, 1 fig, 2 tab, 12 ref, 1 append.

Descriptors: *Waste water treatment, Water pollution control, *Water policy, Standards, Evaluation, *Analytical techniques, Mathematical models, Marginal utility, Constraints, Optimization, *Economic efficiency, *Zoning, Dissolved oxygen.
Identifiers: Integer programming, Zoned uniform treatment, Balas algorithm.

An integer programming algorithm was presented and used to obtain the least total cost waste water treatment solution under zoned uniform treatment constraints for the Delaware Estuary. A branch-and-bound algorithm was used to ensure only one treatment level per zone in the optimal solution. Starting at an arbitrary solution the algorithm systematically checked for feasibility, brought in new variables (treatment levels), evaluated the technical and economic feasibility of abandoning or continuing with a partial solution, and proceeded by the elimination of dominated solutions to an optimum. The results of a digital computer study for the Delaware Estuary using this 'Balas' algorithm were tabled.
W68-01161

ADAPTATION BY MICROBIAL POPULATIONS,
Cornell Univ., Ithaca, N. Y.
Norman C. Dondero, and T. B. S. Prakasam.
Progress Report to Federal Water Pollution Control Administration, 1967-1968, WP-01034, 38 pp., 15 fig., 15 tab.

Descriptors: Acclimatization, Activated sludge, Aerobic bacteria, Aquatic bacterial nutrients, Organic compounds, Sewage bacteria, Sewage treatment, Trickling filter.

To characterize and differentiate between microbial populations from different environments or before and after environmental stresses it is necessary to describe the populations. A nutritional characterization of the aerobic heterotrophs based on Lochhead's nutritional scheme for soil microorganisms. Culture media have been ranked for plate count productivity for activated sludges, trickling filter slime, and bacterial plankton of Cayuga Lake. Activated sludge extract agar was consistently best for activated sludge bacteria, meat extract peptone agar for sewage, and a peptone-caseinate, starch-glycerol agar (Taylor's) for the lake bacteria. Trickling filter bacteria grew well on activated sludge extract media. Of trickling filter bacteria, 63% required only glucose and salts, 15% needed amino acids, 5-15% needed accessory growth factors. About 10% needed growth factors in activated sludge extract or trickling filter slime extract. Trickling filter bacteria were able, in general, to attack more organic substrates and to a greater extent than lake water bacterial in respirometric tests. (Authors)
W68-01168

THE HIERARCHY OF WATER QUALITY,
North Carolina Univ., Department of Environmental Sciences and Engineering, Chapel Hill.
For primary bibliographic entry see Field 03D.
For abstract, see .
W68-01257

5E. Ultimate Disposal of Wastes

CHARACTERISTICS OF INTERFACE FLOW IN SUBSURFACE DISPOSAL SYSTEMS,
Michigan Technological Univ, Houghton.
For primary bibliographic entry see Field 05G.
For abstract, see .
W68-01245

DIVERSION OF LAKE MICHIGAN WATERS,
Detroit Univ.
Paul L. Adams.
U of Detroit L J, Vol 37, No 1, pp 149-156, Oct 1959. 8 p, 6 ref.

Descriptors: *Lake Michigan, Great Lakes, Political aspects, Sewerage, Sewage disposal, Legislation, *Permits, *Illinois, Diversion structures, Ditches, Legislation, Federal government, *International waters.

This article concerns the Chicago water diversion controversy which began between 1892 and 1900, when Chicago decided to initiate a sewage disposal program, requiring the diversion of Lake Michigan waters. Previous permits from the Secretary of War authorized Chicago to divert 4,167 c.f.s. of water. Its request for 10,000 c.f.s. was denied. An injunction sought by the United States to limit Chicago's diversions to the original permits was granted and upheld in the Supreme Court. When the next Secretary of War granted a temporary permit to divert 8,500 c.f.s., various states joined in an original suit in the U.S. Supreme Court to enjoin Illinois and the Chicago Sanitary District, from continuing the diversion. The court held that the Secretary had acted outside his authority and entered a decree requiring gradual reductions in the diversions. Compliance with this decree was reluctant and incomplete. Two bills allowing increased diversions were passed by Congress but both were vetoed. The Great Lakes States also began a suit to require Illinois to return the used water to Lake Michigan. The suit was still pending when this article was written. Steps to thwart diversions by other Illinois towns are related.
W68-01380

5F. Water Treatment and Quality Alteration

PROBABILISTIC MODELS FOR PREDICTING STREAM QUALITY,
Cornell Univ., Ithaca, N. Y.
D. P. Loucks, and W. R. Lynn.
Water Resources Res, Vol 2, No. 3, pp 593-605, July-Sept. 1966. 13 p, 4 fig, 3 tab, 18 ref.

Descriptors: Biochemical oxygen demand, Distribution patterns, Dissolved oxygen, Economic efficiency, Markov processes, Water quality control, *Mathematical models, Oxygen sag, *Probability, Sewage effluents, *Sewage treatment, Standards, Stream improvement, *Stochastic processes, Water policy, Water pollution control.
Identifiers: Transition probabilities, Matrix, Probabilistic models.

Mathematical models were developed to predict the probability distribution of minimum dissolved oxygen concentrations occurring downstream from any particular waste water treatment facility. Four models were presented based on different assumptions of average daily stream and sewage flow conditions. The relationship between dissolved oxygen content and initial BOD concentration was based on a modification of the Streeter-Phelps equation. The transition probabilities for daily streamflows were assumed to be described by a first-order Markov process. The four models used the following assumptions respectively: (1) a fixed BOD concentration for each daily sewage flow; (2) a range of possible BOD's per flow; (3) fixed BOD's but serially and cross correlated sewage and stream flows; and (4) as (3) but with a range of BOD's. Using a hypothetical example, distributions of min DO concentrations in a stream were determined for 1, 2, and 3-day periods. It was concluded that results from the model could be used as a basis for selecting the degree of waste water treatment as well as for establishing more realistic stream quality standards.
W68-01149

WASTE RECOVERY AND POLLUTION ABATEMENT,
Robert N. Rickles.
Chem Eng, Vol 72, No 20, pp 133-136, Sept 27, 1965. 4 p, 4 tab.

Descriptors: *Legislation, *Administrative agencies, Federal government, Water pollution control, *Waste water treatment, State governments, Research and development, Taxes, Legal aspects, Local governments, Pollution abatement, Financing.
Identifiers: Tax incentives.

This article deals almost entirely with technical methods of waste water treatment. A short discussion of federal, state, and local governmental activity in the water pollution control field is included (pp 133-135). Tables of (1) non-federal governmental agencies concerned with water pollution control, (2) governmental research and development agencies dealing with water pollution control, and the mission of each of these agencies, and (3) state assistance to industry for waste treatment facilities, are included. Key provisions of Senate Bill 1670, providing tax incentives for industries expending money on pollution control facilities, are set out. (Kirkconnell-Fla)
W68-01322

5G. Water Quality Control

A STUDY IN THE ECONOMICS OF WATER QUALITY MANAGEMENT,
Federal Water Pollution Control Administration, U.S. Department of the Interior, Washington, D. C.
Edwin L. Johnson.
Water Resources Research, Vol 3, No 2, pp 291-305, Second Quarter 1967. 15 p, 2 fig, 9 tab, 3 ref.

Descriptors: *Biochemical oxygen demand, *Water quality, Regional analysis, Constraints, Capital costs, Administrative costs, *Effluents, Efficiencies, Equitable apportionment, Marginal costs, Summer, *Pollution abatement.
Identifiers: *Waste dischargers, Delaware Estuary, *Single effluent charge, *Zone effluent charge, Economic incentives.

Several methods of allocating waste reductions among dischargers are available to water pollution control administrators. The effluent charge is the most recent addition to this collection. In this study comparisons were made of two effluent charge schemes, a least-cost allocation and a more conventional uniform removal approach to load allocation, in the attainment of several water quality-improvement goals. The results indicate that the effluent charge concept should be seriously considered as a means of attaining dynamic waste discharge situations, to describe discharger response more fully, and to define administrative problems and costs. (Seneca-Rutgers)
W68-01051

RECREATION BENEFITS FROM WATER POLLUTION CONTROL: A FURTHER NOTE ON BENEFIT EVALUATION,
California Univ., Berkeley.
For primary bibliographic entry see Field 06B.
For abstract, see .
W68-01055

LINEAR PROGRAMMING MODELS FOR WATER POLLUTION CONTROL,
Cornell Univ., Ithaca, N. Y.
Daniel P. Loucks, Charles S. Revelle, and Walter R. Lynn.
Manage Sci, J The Inst Manage Sci, Vol 14, No 4, pp B-166-181, Dec 1967. 16 p, 5 fig, 4 tab, 10 ref, 1 append.

Descriptors: Biochemical oxygen demand, Constraints, Dissolved oxygen, Economic efficiency, *Linear programming, *Mathematical models, Oxygen sag, *Oxygen requirements, Sewage treatment, Standards, Stream improvement, Water management (Applied), *Water pollution control, Water policy, Waste water treatment, Sewage effluents.
Identifiers: DO standards, Sensitivity analysis.

Two deterministic linear programming models were presented for determining the amount of wastewater treatment required to achieve at minimum cost any particular set of stream dissolved oxygen standards within a river basin. The models were derived from the generalized Streeter-Phelps equations. Stream quality standards were expressed as constraints on the DO and BOD levels allowed in each reach. A hypothetical example illustrated the use of the models. The models were adaptable to any river basin configuration. The results from two examples, one with DO standards in each reach lowered by 0.5 mg/1, illustrated the sensitivity of the system to quality standard changes. The effect of constraining the system for equal treatment at all plants was discussed. It was concluded that in addition to minimum treatment cost solutions, the models could be used to evaluate the sensitivity of the system to changes in the physical or economic parameter.
W68-01159

USE OF SYSTEMS ANALYSIS IN ESTUARINE WATER POLLUTION CONTROL,
Public Health Service, Philadelphia, Pa.
Robert V. Thomann.
Western Resources Conf, Univ. of Colorado Press, pp 47-59 1964. 13 p, 5 fig, 1 tab, 5 ref.

Descriptors: *Systems analysis, *Water pollution control, Input-output analysis, *Estuaries, Linear programming, Mathematical model, Dissolved oxygen, Water policy, Standards, Waste water treatment, Flow characteristics, Optimization.
Identifiers: Delaware Estuary.

Concepts and examples of systems analysis techniques in the structuring and optimization of estuarine water quality models were presented. Dissolved oxygen was used as the primary indicator of water quality. The concept of the mathematical model as an input-output relationship which described a physical system was introduced. A DO model based on the Streeter-Phelps formulation was presented as an example and some results of the Delaware Estuary study were graphed. The incorporation of the DO model into a least-cost water pollution control linear programming model was described. The effects of different flow regimes and various policies and quality standards on the optimal solution were discussed. Two least-cost solutions from the Delaware study for two levels of DO standard were tabled. Further areas of research were proposed.
W68-01162

A STUDY IN THE ECONOMICS OF WATER QUALITY MANAGEMENT,
U. S. Department of the Interior, Washington, D. C.
Edwin L. Johnson.
Water Resources Res, Vol 3, No. 2, pp 291-305, 2nd Quart 1967. 17 p, 2 fig, 9 tab, 3 ref.

Descriptors: *Linear programming, Digital computers, Dissolved oxygen, Economic efficiency, Estuaries, Economics, Sampling, Sewage effluents, *Standards, Stream improvement, *Waste water treatment, Water management (Applied), *Water policy, *Water quality control, *Cost comparisons, Sludge disposal, Diffusion, Marginal costs.
Identifiers: Effluent charges, Least-cost method, Delaware Estuary.

Linear programming techniques were used to compare four methods of allocating waste reductions among dischargers. Reductions were required to attain various DO standards for the Delaware Estuary. The four methods compared were: (1) Uniform Treatment (UT) for all dischargers; (2) Least Cost (LC) based on marginal costs of treating; (3) Single Effluent Charge (SECH) to all dischargers in the estuary; and (4) Zone Effluent Charge (ZECH) varying with geographic location. The results indicated that the effluent charge schemes were capable of achieving improvements at a cost approaching that of the least cost plan. The impact on the regional economy was not expected to be significantly different under any of the schemes studied. However, the efficiency and equity characteristics of the effluent charge techniques appeared superior to those of more conventional techniques. It was concluded that additional studies in the application of effluent charges were needed, to cope with differential charges relating to dynamic waste discharge situations, to describe discharger response more fully, and to define administrative problems and costs.
W68-01165

DELAWARE ESTUARY COMPREHENSIVE STUDY, PRELIMINARY REPORT AND FINDINGS.
Dept of the Interior, Fed Water Pollut Contr Admin, Philadelphia, Pa.

Delaware Estuary Compr Study, Prelim Rep and Findings, July 1966. 94 p, 46 fig, 21 tab, 2 append.

Descriptors: Water quality control, Computer programs, Dissolved oxygen, Comparative benefits, Comparative costs, *Estuaries, Evaluation, Flow augmentation, Future planning (Projected), Industrial wastes, Municipal wastes, Mathematical models, *Simulation analysis, *Stream improvement, Water policy.
Identifiers: Delaware estuary.

The results of the Delaware Estuary Comprehensive Study were presented. The history of the pollution problem and a physical description of the water quality and water demand requirements of the estuary were given. Five quality objective sets of the study were presented, ranging from the

highest quality (set I) to the maintenance of the present quality level (set V). Four waste reduction schemes were evaluated. They were (1) uniform treatment for all sources; (2) equal waste reduction by zones; (3) equal waste reduction by industrial or municipal categories; and (4) a total minimum cost scheme. Other alternatives such as waste piping, flow regulation and instream aeration were evaluated. A computer simulation model was used to forecast the time varying DO profiles for various flow conditions and oxygen demanding loads. Results of the study are shown in figures and tables. The report recommended intermediate objective set III as the policy objective for the estuary.
W68-01167

INSECTICIDES IN TILE DRAINAGE EFFLUENT,
California Univ, Los Angeles; State Dept. of Water Resources, Fresno.
William R. Johnston, F. T. Ittihadieh, and R. Kenneth Craig.
Water Resources Res, Vol 3, No 2, pp 525-537, 1967. 13 p, 4 fig, 10 tab.

Descriptors: *Irrigated land, Drainage systems, *Insecticides, Groundwater, Southwest US, *Tile drainage, Effluents, Tailwater, Water quality.

The type and quantity of insecticide material found in irrigated agricultural soils was determined in the San Joaquin Valley of California. An experimental field plot consisting of 100 acres was divided into three blocks each consisting of seven different tile lines. The central block received applications of DDT and Parathion and was followed by floodings of the block. Lindane was applied before the last flooding. Four gallon composite effluent samples from seven tile drains, samples of applied water and tailwater were collected and were analyzed for insecticide residue. Tailwater contained from 7 to 12 times the amount of residue as the applied water when DDT was used and 85 times as much residue when Lindane was used. Large concentrations of residue were found in the surface soil although there was no direct application. (Affleck-Ariz)
W68-01191

CHARACTERISTICS OF INTERFACE FLOW IN SUBSURFACE DISPOSAL SYSTEMS,
Michigan Technological Univ, Houghton.
Henry S. Santeford, Jr., and George Alger.
Mich Technol Univ, Dept Civil Engr, OWRR report, 14 p, June 1968. 9 fig, 17 ref.

Descriptors: *Flow, *Soil disposal fields, *Interfaces, *Porous media, *Septic tanks, Pipe flow, Open-channel flow, Infiltration, Drainage engineering, Subsurface drainage.
Identifiers: *Interface flow, Dosing chambers.

A test in a sand-box model of the distribution of effluents in septic tank drainage pipes and on the soil-trench interface in the absorption field showed that constant-flow effluent could not be distributed evenly along any commonly used pipe and that pipe slope had little if any effect on distribution of effluent in the trench. Changing flow rate had little effect on the length of trench bottom covered. The aggregate in the trench had very little effect; flow was mainly along the bottom trench-soil interface. Total outflow was through the bottom. As clogging began, the flow front moved from its initial rest position and up the trench at a decreasing rate. With a dosing chamber used to fill the pipe, a flow rate of about 200% of pipe volume caused even distribution of effluent in pipe and trench, and outflow was through the sides as well as the bottom. Clogging occurred over the whole trench length at once and because sediment was applied uniformly rather than at a point up-flow, no reduction in clogging rate with time occurred. Trench failure occurred in 30% less time than with constant-flow conditions. (Knapp-USGS)
W68-01245

ADSORPTION CATALYZED CHEMICAL HYDROLYSIS OF ATRAZINE,
Wisconsin Univ. Madison.
For primary bibliographic entry see Field 03F.
For abstract, see .
W68-01246

REGULATORY ASPECTS OF FEDERAL POLLUTION CONTROL,
Murray Stein.
Denver L J, Vol 45, No 2, pp 267-278, Spring 1968. 12 p, 24 ref.

Descriptors: *Federal Government, *Legislation, *Water pollution control, *Administration, Rivers and Harbors Act, Water Quality Act, Judicial decisions, Water quality control, Administrative agencies, Industrial wastes, Municipal wastes, State governments, Navigable waters, International waters, Riparian rights, Conferences.

Early judicial opinions established the principle that water must not be polluted so as to destroy or greatly impair its value to the lower riparian owner. With urbanization and industrialization came more widespread pollution. Judicial principles were applied only in litigation. Congress may legislate to prevent water pollution by virtue of the commerce clause. The first federal pollution legislation was the Rivers and Harbors Act of 1899. There was little legislation prior to World War II. Comprehensive legislation was attained in 1956 and 1961 by amendments to the Water Pollution Control Act of 1948. State responsibilities were stressed. The Water Quality Act of 1965 made extensive changes. The most important provision is Section 10 (c) (1), which established national water quality standards. The Interior Department is instrumental in aiding states in meeting these standards. The Secretary of the Interior is empowered to enforce quality standards under the 1965 amendments. International waters are regulated by the Clean Water Restoration Act of 1966. Cooperation between the federal government and the states is accomplished by specified procedures: conferences, public hearings, and court action. (Breuel-Fla)
W68-01302

WAR AGAINST WATER POLLUTION GETS MORE LIVELY.
Chem Eng, Vol 73, No 11, pp 88-92, May 23, 1966. 3 p, 1 photo.

Descriptors: *Legislation, Federal government, *Industries, Water pollution, *Water pollution control, Planning, *Taxes, Waste water treatment, *Pollution abatement, Legal aspects, Industrial wastes, Effluents, Industrial plants.
Identifiers: Clean Water Act, Effluent charges.

Proposed legislation dealing with water pollution control by industry is reviewed. Two main plans to eliminate industrial pollution are (1) allow industries quick tax writeoffs on pollution control equipment, and (2) impose an effluent charge on industries contributing to stream pollution. One objection to the first plan is that it would penalize industries which have already invested heavily in pollution control equipment. Under the second plan, charges imposed for discharging effluent into a stream would be used to build large treatment plants. Industry generally favors the tax writeoff plan. The Clean Water Act, which provides for stream classification as to desired use, i.e., swimming, pleasure boating, industrial, is noted. (Kirkconnell-Fla)
W68-01304

TEN YEARS OF PROGRESS IN POLLUTION ABATEMENT.

Public Works, Vol 96, No 7, pp 72-73, July 1965. 2 p, 1 fig, 1 map.

Descriptors: *Federal government, *Legislation, *Pollution abatement, Financing, Water pollution control, Water pollution, River basins, *Government finance, Grants, Legal aspects, Water resource development.
Identifiers: Enforcement procedure, Comprehensive studies.

The first formal federal water pollution control act was passed in 1948, and the first permanent federal pollution act was passed in 1956. The 1956 act was a 4 point federal program to combat pollution. There were to be (1) grants to municipalities to support waste treatment plant construction, (2) enforcement powers including the government in interstate pollution cases, (3) comprehensive river basin planning for pollution control, and (4) research, both intramural and extramural. The thrust of the federal program from the beginning was to aid the smaller communities with pollution problems. It was not until after the 1956 Act that the federal enforcement procedure was developed. Federal research in the area of water pollution control has steadily increased. Long range comprehensive studies are now under way in 8 major river basins. The article deals largely with the amount of federal money appropriated for various aspects of pollution control. (Kirkconnell-Fla)
W68-01321

PROTECTING OUR WATER RESOURCES,
Committee on Bar Ass'n Q, Harrisburg, Pa.
For primary bibliographic entry see Field 03F.
For abstract, see .
W68-01345

LEGAL BASIS FOR WATER POLLUTION CONTROL,
Institute of Law and Government, School of Law, Georgia Univ., Athens.
For primary bibliographic entry see Field 06E.
For abstract, see .
W68-01352

WATER POLLUTION CONTROL IN NORTH CAROLINA,
Institute of Law and Government, College of Law, Georgia Univ., Athens.
For primary bibliographic entry see Field 06E.
For abstract, see .
W68-01353

WATER QUALITY CONTROL ACT OF 1965.

33 U S C A Sec 466 (1965 Supp), pp 29-57. 28 p, (79 Stat 903).

Descriptors: *Legislation, *Administrative agencies, Administration, Federal government, Pollution abatement, Water pollution control, *Grants, Project planning, Projects, Research and development, Interstate compacts, Cities, Sewage treatment, Municipal wastes, *Water Quality Act.
Identifiers: *FWPCA.

The act amends the Federal Water Pollution Control Act to provide for an additional position of assistant Secretary of Health, Education and Welfare and to create the Federal Water Pollution Control Administration (FWPCA). The act makes appropriations for grants to interstate, state and local agencies for research, planning and development of new methods of pollution control. Existing appropriations are increased. Procedures are provided for the establishment of water quality control standards for interstate waters. The Secretary of Health, Education and Welfare is authorized to initiate abatement proceedings to remedy pollution problems. Interstate compacts and uniform state laws are encouraged. The Water Pollution Control Advisory Board is created to advise, consult with, and make recommendations to the secretary. (Williams-Fla)
W68-01359

ATER PURITY: A STUDY IN LEGAL CONROL OF NATURAL RESOURCES,
arl F. Murphy.
niversity of Wisconsin Press, Madison, pp 1-212, 961. 212 p, 330 ref.

escriptors: *Wisconsin, *Administration, *Water ollution control, *Legislation, Regulation, Histo-, Water resources, Water purification, Water anagement (Administrative), Local governents, Administrative agencies, Water pollution, onservation, Regulation, Water quality control, ederal government, Public health, Cities, Sewage, ater law.

ne focus of the study is on Wisconsin's adminisative control of water resources and pollution. ne approach is historical. The bases of resource gulation is discussed with special consideration ven to water pollution and surface waters and ound waters, federal government views, and Enish precedents. The nineteenth century is the ginning focal point. Topics covered included: llution sources, public health, municipal oblems, sewage and industrial wastes. The transion to central administrative control is discussed. mphasis is on local governments and state agenes. The judiciary is also discussed. The next topic the development of central state agencies. mphasis is on the State Board of Health, the owth of administrative jurisdictions and powers, well as the role of the federal government. The stem of diversification of agency responsibilities discussed. Wisconsin has a central committee presentative of all other resource agencies. ooperation among agencies is stressed. The book ncludes with a summary and prospect for future ater pollution control as well as general resource evelopment.
/68-01360

ASES OF RESOURCE REGULATION,
or primary bibliographic entry see Field 06E.
or abstract, see .
/68-01362

RANSITION TO CENTRAL ADMINISTRAIVE CONTROL,
or primary bibliographic entry see Field 06E.
or abstract, see .
/68-01364

EVELOPMENT OF CENTRAL ADMINISRATING CONTROL,
or primary bibliographic entry see Field 06E.
or abstract, see .
/68-01365

PERATION OF THE STATE CENTRAL ADMINISTRATIVE AGENCY,
or primary bibliographic entry see Field 06E.
or abstract, see .
/68-01366

EARINGS ON S4 BEFORE A SPECIAL SUBOMMITTEE ON AIR AND WATER POLLUION OF THE COMMITTEE ON PUBLIC VORKS, UNITED STATES SENATE.
.S. Congress, Senate Comm. on Public Works.

earings on S4 Before a Special Subcomm on Air nd Water Pollution of the Senate Comm on Public Vorks, 89th Cong, 1st Sess, pp 1-54, Jan 18, 1965. 5 p, 1 map, 1 tab.

escriptors: *Legislation, *Administrative agenies, Federal government, Political aspects, Water ollution, Federal-state water rights conflicts, Adinistration, *Water quality control, Water pollon control, *Standards, Water quality, Water uality Act.
dentifiers: *FWPCA.

4, the proposed Water Quality Control Act appeared at the beginning of the record. A letter followed, in which the Secretary of HEW supported the bill. Senator Muskie outlined the history of the bill, and its provisions and relation to administration proposals. The assistant Sec. of HEW appeared in support of S4, and outlined some of the Department's action under the Water Pollution Control Act. He provided a table reflecting the federal, state and local contributions to construction of municipal sewage treatment facilities in 1963 and 1964. Also provided were reports on the progress and status of the programs of major river basin studies, and of control of pollution from federal installations, which were explained. Finally a report was submitted outlining enforcement actions and actual enforcement conferences called by the Secretary under the Water Pollution Control Act. There followed a discussion between Sen. Muskie and representatives of the manufacturing Chemists Assoc. in regard to the effect of, promulgation, and enforcement of, standards for the quality of interstate waters authorized by the bill. The Assoc. argued for more state control, and other modifications of the bill. (Williams-Fla)
W68-01369

HEARINGS ON S4 BEFORE A SPECIAL SUBCOMMITTEE ON AIR AND WATER POLLUTION OF THE COMMITTEE ON PUBLIC WORKS, UNITED STATES SENATE.

Hearings on S4 Before a Special Subcomm of Air and Water Pollution of the Senate Comm on Public Works, 89th Cong, 1st Sess, pp 55-139, Jan 18, 1965.

Descriptors: *Legislation, *Administrative agencies, Federal government, Political aspects, Water pollution, Federal-State water rights conflicts, Administration, Water quality control, Water pollution control, *Standards, Water quality, *Water Quality Act.
Identifiers: *FWPCA.

A representative of the Pulp, Paper and Paperboard Institute made statements as to the industry's research and achievements in pollution control, and recommended certain changes in the bill. A copy of the Federal Water Pollution Control Act, with the Institute's recommended changes, as well as changes provided in S4 was included. A statement of support for the bill by a representative of the National Wildlife Federation followed. A further discussion of the standards and abatement provisions took place. The Governor of California appeared in support of the bill, and advocated increased appropriations for sewage treatment and waste water reclamation. A representative of the Delaware River Basin Commission appeared to promote an amendment which would exempt such commissions from the quality standards provision of the act. Discussion followed, in which Sen Muskie opposed the amendment. Various written statements were included in the record. Most of them were from various state agencies, opposing the establishment of the Federal Water Pollution Control Administration (Sec 2 of the bill), and the grant of authority to the Secretary to establish water quality standards for interstate waters (Sec 5). Several statements supported the bill.
W68-01370

WATER POLLUTION CONTROL IN THE GREAT LAKES REGION,
Detroit Univ.
Milton P. Adams.
U of Detroit L J Vol 37, No 1, pp 96-120, Oct 1959. 25 p, 4 tab, 3 ref.

Descriptors: *International Joint Commission, *Water pollution, Fresh water, Legislation, Industrial wastes, Municipal wastes, Standards, Sewage treatment, Public health, Pollution abatement, Sanitary engineering, Treatment facilities, Ultimate disposal, *Water pollution control, Local government, Federal government, Interstate.

The eight Great Lakes states and the Province of Ontario have primary responsibility for control of pollution within their respective jurisdictions. Should interstate pollution problems arise, Public Law 660 of 1956 provides a method by which the Federal government acting through the Surgeon General of the Public Health Service may take a hand. Michigan and Ontario are closest together along the St. Mary's, St. Clair and Detroit rivers. The same relationship exists between New York State and the Province of Ontario along the Niagara River. With water supplies, recreation, waste disposal, navigation concentrated in these restricted international waters, pollution control objectives have developed from the recommendation of the International Joint Commission. The author sets out several tables which indicate: the lakes and their principal connecting waters, the States and the Province having frontage on each of the Great Lakes, major shoreline and inland cities, the division of the 200,000 square miles of land within the basin and the miles of shoreline possessed by each sovereignty.
W68-01392

06. WATER RESOURCES PLANNING

6A. Techniques OF Planning

OPTIMAL GROUND-WATER MINING,
Desert Research Institute, Nevada Univ., Reno.
P. A. Domenico, D. V. Anderson, and C. M. Case.

Water Resources Res, Vol 4, No 2, pp 247-255, April 1968. 9 p, 3 fig, 10 ref.

Descriptors: *Ground-water mining, Mathematical models, *Hydrologic aspects, Ground-water basins, Water levels, Storage capacity, *Economics, *Optimization, Decision making, Equations, Water management (Applied), Recharge.
Identifiers: Mining yields, *Economic aspects, Optimal yield.

A method employing formulation, solution and evaluation of a mathematical model that retained the conventional practices of management in the western U S was developed by the Desert Research Institute, Reno, Nevada. Hydrologic and economic aspects of managerial concepts were quantified through a derivation of optimal mining yield and associated decision rules. Mining yields defined an exhaustible resource of fixed supply since they were treated as volumes of non-renewable water in storage independant of rate of mining. Sustained yields were treated as use rates determined and limited by natural replenishments. Since depth to ground water is generally of primary concern to users, change in water level was taken as the common denominator between the system and its economic evaluation. Maximizing conditions were expressed in terms of verbal decision rules and gave new interpretation to the overdevelopment generally associated with exceeding safe yield. (Afleck-Ariz)
W68-01110

INDUS RIVER BASIN STUDIES.
Harvard Univ., Cambridge, Mass.
For primary bibliographic entry see Field 03C.
For abstract, see .
W68-01148

PROBABILISTIC MODELS FOR PREDICTING STREAM QUALITY,
Cornell Univ., Ithaca, N. Y.
For primary bibliographic entry see Field 05F.
For abstract, see .
W68-01149

OPTIMAL POLICY FOR HYDROELECTRIC OPERATIONS,
Stanford Univ., Stanford, Calif.
For primary bibliographic entry see Field 08C.
For abstract, see .
W68-01150

A PROBLEM OF OPTIMIZING A COLLECTING RESERVOIR SYSTEM,
Technion, Israel Institute of Technology, Haifa.
For primary bibliographic entry see Field 08A.
For abstract, see .
W68-01151

LINEAR DYNAMIC DECOMPOSITION PROGRAMMING APPROACH TO LONG-RANGE OPTIMIZATION OF NORTHERN CALIFORNIA WATER RESOURCES SYSTEM, PART I: DETERMINISTIC HYDROLOGY,
California Univ., Berkeley.
Shailendra C. Parikh, and Ronald W. Shephard.
Rep, Oper Res Center, No ORC 67-30, Univ. of California, Aug 1967. 67 p, 12 fig, 6 photo, 6 tab, 5 ref.

Descriptors: *Parametric hydrology, *Linear programming, Monthly, Water resources development, *Reservoir operation, Water demand, Electric power demand, *Long-term planning, *River basins, Pumped storage, Scheduling, Optimization, Dynamic programming, Irrigation, Analytical techniques.
Identifiers: Decomposition method, Central Valley Project, Northern California, Firm commitments, Target outputs.

A linear dynamic decomposition programming model, using deterministic hydrology, was structured for the Central Valley Project in the Northern California Water Resources System. The objective was to find long-range target outputs of water and energy that maximized the net revenue returns from demand commitments to farmers and the utility company. System variables were the average monthly energy and water flows for a 10-year period. Terminal storage requirements and evaporation losses were assumed known. Pumping costs were assumed equal to firm and dump energy prices in on and off peak hours. Firm commitments were required to be met. Two solution approaches, one treating the San Luis reservoir as a subsystem, and the other treating the reservoir as system constraint, were described. Computer results were tabled. Schematic representations of the rean and simplified systems and their components were appended.
W68-01152

MATHEMATICAL MODELS: THE MULTISTRUCTURE APPROACH; TWO SEASONS, PREDICTABLE HYDROLOGY,
Harvard Univ., Cambridge, Mass.
Robert Dorfman.
Design of Water-Resource Systems, Maass et al, Harvard Univ. Press, Chapt. 13, pp 494-512, 1962. 19 p, 3 fig, 3 tab, 3 ref.

Descriptors: Linear programming, *Approximation method, Economic efficiency, Mathematical models, *River basin development, *Multiple-purpose projects, Parametric hydrology, Reservoir design, Irrigation design, Hydroelectric plants, Seasonal, Water demand, Water distribution (Applied), Benefits.
Identifiers: Deterministic hydrology, Weighted averages, Separable functions.

Methods were developed for using linear programming techniques to study river basin planning problems that involve non-linear objectives and constraints. A hypothetical example consisted of 2 reservoirs, an irrigation district, and a power plant. Deterministic inflows for 2 seasons were assumed. The objective was to determine the reservoir capacities, irrigation supply and power plant output which would maximize the net benefit for the system. Non-negativity and system demand constraints were defined. The objective function and the power constraint contained separable non-linear functions. Values of these functions were determined at discrete intervals. A linear programming model was structured and used to determine a unique set of weights applied to each discrete value in order to solve the original problem. A method of observational checking of the solution was described which guaranteed a feasible solution.
W68-01153

COMPUTER MODELS FOR RESERVOIR REGULATION,
Cornell Univ., Ithaca, N. Y.
Daniel P. Loucks.
Amer Soc Civ Eng Conference Reprint 534, Oct 16-20 1967. 26 p, 2 fig, 3 tab, 2 ref, 2 append.

Descriptors: *Linear programming, *Reservoir operation, *Synthetic hydrology, Regulated flow, Water allocation (Policy), *Markov Processes, Statistical models, Risks, Economic efficiency, Forecasting, Frequency analysis, Distribution patterns, Seasonal, Least squares method, Computer models, Electric power production.
Identifiers: Target allocations, Finger Lakes, N. Y.

Stochastic linear programming models were structured for defining alternative policies for regulating reservoirs. These models were applied to some of the Finger Lakes in New York. Since total benefits and losses were partly intangible, the policy objective was to minimize the sum of the expected squared deviations from various proposed storage and discharge targets. In addition to defining operating policies, the models provided information on the probability distributions of reservoir volumes and discharges that result from the policies. Hence, evaluation of alternative target volumes and discharges was possible. Net inflows were assumed to be serially correlated random variables whose probability distributions could be predicted from past inflows. The computer program, written for the IBM 360 system required only inflow transition probabilities, maximum range of reservoir volumes, discharges and time periods, and the policy objectives desired. A simplified example using hypothetical data for one of the Finger Lakes illustrated the use of the model.
W68-01154

OPTIMIZING CONJUNCTIVE USE OF SURFACE WATER AND GROUNDWATER,
Utah State Univ., Logan.
For primary bibliographic entry see Field 02A.
For abstract, see .
W68-01155

THE OPTIMUM MANAGEMENT OF GROUND WATER RESOURCES,
California Univ., Los Angeles.
For primary bibliographic entry see Field 04B.
For abstract, see .
W68-01156

A COMMENT ON OPTIMIZATION METHODS FOR BRANCHING MULTISTAGE WATER RESOURCE SYSTEMS,
Cornell Univ., Ithaca, N. Y.
D. P. Loucks.
Water Resources Res, Vol 4, No 2, pp 447-450, April 1968. 4 p, 1 fig, 4 tab, 2 ref.

Descriptors: *Analytical techniques, *Dynamic programming, Economic efficiency, Estimated benefits, *Linear programming, Marginal utility, *Mathematical models, Optimization, Probability, Reservoir operation, River systems, *Water resources, Water resources development, Approximation method.
Identifiers: *Nonlinear programming, Lagrangian multipliers, *Multistage systems, Branching systems, Joint probability.

Linear and non-linear programming solutions we presented as alternative mathematical pr gramming techniques for the solution of branching multistage river-reservoir proble originally studied in another paper using dynam programming. The original problem was given a its dynamic programming solution tabled. T problem was then modelled using the followi techniques: (1) non-linear programming (usi Lagrangian multipliers); (2) linear programmi (using linear segments to approximate the conca utility functions); and (3) linear programming (u ing as variables the joint probabilities of vario discrete reservoir volumes, inflows and releases The solutions for the three methods were table The optimal storage allocations using all metho were compared. It was concluded that mar mathematical techniques may be used to analy water resource systems problems.
W68-01158

LINEAR PROGRAMMING MODELS FO WATER POLLUTION CONTROL,
Cornell Univ., Ithaca, N. Y.
For primary bibliographic entry see Field 05G.
For abstract, see .
W68-01159

USE OF MODERN EQUIPMENT AN TECHNIQUES IN THE PLANNING AN DEVELOPMENT OF WATER RESOURCES,
Harza Engineering Company.
Rolland F. Kaser, and Stephen V. Allison.
Proc Int Conf Water for Peace, Pap No P/40 Washington, D. C., May 1967. 12 p, 2 fig, 2 tab.

Descriptors: *Water resources development, Pro ject planning, *Multiple-purpose projects, *Simu lation analysis, Reservoir operation, *Irrigatio systems, River basin development, Digital compu ters, Computer programs, Analytical technique Groundwater, Mathematical models, Salinity.
Identifiers: *Indus River Basin, Sensitivity analysis

The use of systems analysis techniques in th planning and development of water resources wa discussed, and illustrated by a description of th simulation models of the Indus River Basin. Th development and use of computers were describe Mathematical models emphasizing system simula tion and sensitivity analysis were discussed. Th background and objectives of the Indus Basin simu lation model were presented, and the system com ponents were listed. The model simulated the Indu River and six major tributaries, six potential reser voirs, twenty river diversions, eleven canal link and 45 separate canals covering 30 million acres land, for a 50-year period of analysis. The com puter program and several of its subroutines wer described. The uses of the model were listed an discussed. Supporting programs for supplying inpu data were described. Sample output data was ta bled.
W68-01160

BALAS ALGORITHM FOR ZONED UNIFORM TREATMENT,
Johns Hopkins Univ., Baltimore, Md.
For primary bibliographic entry see Field 05D.
For abstract, see .
W68-01161

USE OF SYSTEMS ANALYSIS IN ESTUARIN WATER POLLUTION CONTROL,
Public Health Service, Philadelphia, Pa.
For primary bibliographic entry see Field 05G.
For abstract, see .
W68-01162

MATHEMATICAL MODELS: THE MULTI TRUCTURE APPROACH; MORE PERIOD PREDICTABLE HYDROLOGY,
Harvard Univ., Cambridge, Mass.
Robert Dorfman.

Design of Water-Resource Systems, Maass et al, arvard Univ. Press, in Chapt 13, pp 512-524, 962. 13 p, 1 fig, 6 tab, 1 ref.

escriptors: *Linear programming, *Constraints, Seasonal, Mathematical models, *Multiple-purse projects, River basin development, Parametc hydrology, Analytical techniques, Water deand, Water distribution (Applied), Benefits, Opmization.
lentifiers: Deterministic hydrology, Decomposion principle.

he decomposition principle was used to reduce a ghly constrained linear programming model to anageable proportions. A hypothetical river basin cluding a reservoir, an irrigation district and a ydro power plant was described. Deterministic inows and demands for irrigation and energy were ven for 4 seasons. Constraints for the problem ere defined, and subdivided into groups containg decision variables relating to (1) one period nly; (2) two adjacent periods; and (3) all four eriods. A single constraint for each period was ien obtained by a linear programming subopmization model and inserted into the master near programming model. The computations for ne of the time periods were shown. The procedure or systematic improvement of the individualeriod solutions toward the master problem opmum were described. The results, including the alue of the dual variables for the master contraints, were tabled.
V68-01163

UGAR CANE IRRIGATION: A CASE STUDY N CAPITAL BUDGETING,
McKinsey and Company, Inc., San Francisco, Calif.
For primary bibliographic entry see Field 03F.
For abstract, see .
V68-01164

MATHEMATICAL MODELS: THE MULTISTRUCTURE APPROACH; ALLOWANCE FOR UNCERTAINTY,
Harvard Univ., Cambridge, Mass.
Robert Dorfman.
n Design of Water Resource Systems, Maass et al, Harvard Univ Press, in Chapt. 13, pp 524-539, 1962. 15 p, 1 fig, 7 tab, 1 ref.

Descriptors: *Linear programming, *Synthetic ydrology, Mathematical models, Distribution patterns, Probability, *River basin development, *Multiple-purpose projects, Benefits, Optimization, Water distribution (Applied), Simulation analysis, Statistical methods.
Identifiers: Expected values, Net benefits, Shortage cost, Dump energy.

A stochastic linear programming model was structured for a simple reservoir-hydroelectric power-irrigation system having independent random inflows. Two hypothetical examples were solved. Probability distributions and economic and physical data for all seasons were given. The objective was to maximize the expected net benefits for the system. The objective function was derived, and a technique for linearizing the discontinuous shortage cost function was given. Random variables in the objective function and constraints were replaced by their expected values, derived from the assumed inflow probability distributions. The results of a 3-season example, were compared with a simulation study of the same system. The effect of the simplifying assumptions incorporated in the model were discussed.
W68-01166

6B. Evaluation Process

WATER DATA FOR METROPOLITAN AREAS,
U. S. Geological Survey.
For primary bibliographic entry see Field 07A.
For abstract, see .
W68-01027

RED RIVER BELOW DENISON DAM, LOUISIANA, ARKANSAS, OKLAHOMA AND TEXAS.
U. S. Army Corps. of Engineers, Wash., D. C., Office of Chief of Engineers.

U. S. 90th Congr, 2d Sess, House Doc No 304, 406 p, 1968. 4 append.

Descriptors: *Navigation, *Rivers and Harbors Act, *Transportation, *Bank stabilization, *Cost-benefit ratio, Multiple-purpose projects, Reservoir operation, Water policy, Stage-discharge relations, Flow characteristics, Streambeds, Texas, Oklahoma, Arkansas, Louisiana.
Identifiers: *Channel characteristics, *Red River navigation project.

The results of a study of feasibility and cost-benefit ratio developing the Red River from the Mississippi to Denison dam are reported. Comments by the states of Texas, Oklahoma, Arkansas, and Louisiana and by Federal agencies are included. A navigation project is proposed because sharp curves, caving banks, unpredictable shoaling, and wide fluctuations in stages make the existing river hazardous and undependable for navigation. A usable waterway can be developed only by the employment of locks and dams. The physical description of the river includes channel characteristics, streamflows, bridge crossings, and climatology. Existing water resources projects are listed and described. The economic status of the area is outlined. Problems, needs, and desired improvements in the channel are presented in detail. Plans of improvement, economic evaluation, cost sharing and coordination with other agencies, and general recommendations for action and procedures are presented. Appendices contain hydrologic data, hydraulic design, cost analysis, economic data, construction plans, and reports of other agencies. (Knapp-USGS)
W68-01032

ELECTRICAL-ANALOG ANALYSIS OF GROUND-WATER DEPLETION IN CENTRAL ARIZONA,
U S Geological Survey.
For primary bibliographic entry see Field 04B.
For abstract, see .
W68-01034

WATER IN WEST PAKISTAN,
Syracuse University, Syracuse, New York, Maxwell School of Citizenship and Public Affairs.
Guthrie S. Birkhead.
Water Resources Research, Vol 3, No 2, pp 307-318, Second Quarter 1967. 12 p, 26 ref.

Descriptors: Data collections, Hydroelectric power, Reclamation, Benefits, *Planning, *Investment, *Flood control, *Administration, Surface waters, Storage, Diversion, Drainage, *Dams, *Irrigation, *Canals.
Identifiers: *Mangla Dam, *Tarbela Dam, West Pakistan, *Water and Power Development Authority, Indus Basin Plan.

The article describes several of the salient problems about water and the administration of water programs in West Pakistan. The 1947 separation of India and Pakistan divided the Indus Basin, left three major tributaries in India and most of the irrigated lands in Pakistan. The 1960 Indus Water Treaty provided for a series of waterworks, financed primarily by Western countries, that will reroute much of the surface water in the Basin. Part of the water allotted to India will be replaced, and hopefully there will be a more dependable water supply for the 20 million acres of land in the Province's agricultural base. There and elsewhere severe waterlogging and salinity conditions have been growing rapidly, and other water problems abound. Since 1958 a semi-autonomous government corporation has managed these water programs as well as generating and wholesaling most of the electric power. The corporation currently spends well over a quarter of the total provincial budget for economic development purposes. It may be argued that thus far this Pakistan corporation has performed constructively in the field of water and power resource administration. (Seneca-Rutgers)
W68-01054

RECREATION BENEFITS FROM WATER POLLUTION CONTROL: A FURTHER NOTE ON BENEFIT EVALUATION,
California Univ., Berkeley.
Joseph B. Stevens.
Water Resources Research, Vol 3, No 1, pp 63-64, First Quarter 1967. 2 p, 1 fig, 4 ref.

Descriptors: *Water pollution control, *Water pollution, Benefits.
Identifiers: *Success elasticities, *Consumer surplus, *Willingness to pay, *Incremental benefit, Recreation benefits, Demand function.

In the initial paper, estimates of demand functions and angling 'success elasticities' were presented for three sport fisheries as a basis for determining recreation benefits from water pollution control. Benefits from preventing water pollution would accrue from avoiding a leftward shift of the demand function. The consumer surplus concept was used for measurement of incremental benefits. A nomenclature error was committed in the original formulation. Two alternative measures of incremental benefit are now apparent and are here examined. The first is the consumer surplus analysis as defined by Marshall. An alternative measure of benefit is the change in 'willingness to pay' on the part of the consumers. This analysis represents what was erroneously termed 'consumer surplus' in the previous article. Given these two particular interpretations of incremental benefits, the latter was selected as being more appropriate, for although both methods require some assumption as to rationing units of angling effort among participants, the consumer surplus criterian has an element of inconsistency. Thus, the willingness to pay method is more desirable as a measure of benefit. (Seneca-Rutgers)
W68-01055

SIX FEDERAL RECLAMATION PROJECTS AND THE DISTRIBUTION OF INCOME,
Bowdoin College, Brunswick, Maine.
A Myrick Freeman, III.
Water Resources Research, Vol 3, No 2, pp 319-332, Second Quarter 1967. 14 p, 1 fig, 4 tab, 24 ref.

Descriptors: *Cost-benefit analysis, Discount rate, Income, Welfare, Taxes, Tax rate, *Cost repayment, Farm units, Direct benefits, Alternative costs, *Irrigation programs, Electric power rates.
Identifiers: *Bureau of Reclamation, *Social welfare function, Value judgments, *Redistribution of income, Regional effects.

The major concern of this paper is the effect of Bureau of Reclamation Irrigation Projects on the size distribution of income and means of evaluating these effects. Estimates of the before and after project distributions of income for six recent projects are included. The estimates are based on Bureau data on the sizes of project farms and on benefit and cost data revised by the author. A social welfare function incorporating income distribution is used to calculate welfare weighted benefit-cost ratios for comparison with the revised efficiency benefit-cost ratios normally used in project evaluation. All projects were redistributing income in the 'right' direction. However, only one of the six projects had a welfare-weighted benefit-cost ratio greater than 1. (Seneca-Rutgers)
W68-01056

WATER RESOURCE DEVELOPMENT IN CALIFORNIA,
Resources for the Future, Washington, D. C.
Joseph S. Bain.
Water Research, Edited by Allen V. Kneese, and Stephen C. Smith, pp 51-67, Johns Hopkins Press, Baltimore, 1966. 16 p, 5 tab, 2 ref.

Descriptors: *Water resources development, *Economic efficiency, Cost-benefit ratio, Federal government, State governments, Water allocation, *Central Valley Project, California, Return, Electric power industry, Water utilization.
Identifiers: *Federal Bureau of Reclamation, *Local agencies, Water facilities development, Water usage development.

As in the case of the Central Valley in California, local governments and private companies may partially develop the water resources of a region before the federal government starts a multipurpose water resource development in the area. When this occurs, it is difficult for the federal project to approximate its theoretical potential. Unless it disturbs the existing developments, the federal project often must use marginal and sub marginal land since the best land has already been claimed by the earlier developers in the region. Furthermore, because of the existing developments, often a federal project cannot be built on the optimum scale. Available evidence suggests that the resources in the Central Valley may not be allocated in the most economical manner for a multipurpose operation. For example, from the viewpoint of an efficient multipurpose operation, reservoirs controlled by irrigation districts tend to give insufficient weight to the in-stream recreational uses of water in water allocations and in reservoir release patterns. Similar misallocations of resources occur in state and federal projects. (Seneca-Rutgers)
W68-01058

COMPARISONS OF METHODS FOR RECREATION EVALUATION,
Resources for the Future, Inc., Wash., D. C.
Jack L. Knetsch, and Robert K. Davis.
Water Research, Edited by Allen V. Kneese, and Stephen C. Smith, pp 125-42, Johns Hopkins Press: Baltimore, 1966, 18 p, 2 tab, 10 ref.

Descriptors: *Recreation demand, *Methodology, Maine, Benefits, Recreation.
Identifiers: Willingness to pay, Pittston area, Recreation evaluation.

The best economic measure of recreational values is based upon the consumers' willingness to pay for the recreation services. Two methods have usually been used to determine the consumers' willingness to pay the direct interview approach and the travel cost method. The main problem with the interview method is to determine the degree of reliability of the information received from the respondents. In one study data was obtained about the recreationists' willingness to incur additional costs in order to continue using a recreation area. Data was also obtained about the recreationists' willingness to drive additional distances to use the area. Demand-benefit schedules were constructed from the two sets of data and a significant degree of correspondence was noted between the two schedules. The travel-cost method generates a demand curve by relating travel costs to the number of visits to a recreation area. The basic problem with this approach is its assumption that the disutility of overcoming distance is a function of only money costs. Despite this weakness, the method produces realistic results. (Seneca-Rutgers)
W68-01063

THE USE OF SHADOW PRICES,
California Univ., Los Angeles.
Roland N. McKean.
In Problems in Public Expenditure Analysis, Edited by Samuel B. Chase, Jr., pp 33-65, The Brookings Institution, Washington, D. C., 1968. 33 p, disc.

Descriptors: Monopoly, Oil shale, Research and development, Cost-benefit analysis.
Identifiers: Pareto optimality, Subsidies, Spillovers, Cost of information, *Shadow prices, *Substitution ratios, Market price.

Prices implicit in exchanges that maximize a particular objective function are called shadow prices. Choices about government expenditures are group choices for which there is no ultimately correct preference function. Even assuming a goal of Pareto optimality, market prices may fail to reflect appropriate substitution ratios. They are inappropriate if a benefit-cost analysis pertains to the coming decade and price ratios are soon expected to change in a predictable manner. They are also misleading when at the going price part of a resource is involuntarily unemployed. In the case of externalities the choice regarding derived or adjusted prices seems to hinge on the costs and value of extra information about these effects. It is almost impossible to use programming techniques to solve for shadow prices because of a lack of complete and appropriate preference and production functions. Another method would be to use observed price relationships in markets for similar items or in markets for the same items in other countries, but this can be misleading. Prices implied by other governmental choices might be used, but again these are not necessarily the appropriate ones for maximizing a particular preference function. (Seneca-Rutgers)
W68-01065

WATER RESOURCES ALLOCATION, EXTRAMARKET VALUES, AND MARKET CRITERIA: A SUGGESTED APPROACH,
Oregon State Univ., Corvallis, Oregon Agricultural Experiment Station.
Emery N. Castle, and Herbert H. Steovener.
Oregon Agricultural Experiment Station, Technical Paper No 2387, Nov 1967 23 p, 16 ref.

Descriptors: Public benefits, *Alternative costs, *Externalities, Value, Investment, *Water utilization, Recreation, Water pollution, Water management (Applied).
Identifiers: *Water allocation (Policy), Economics.

The market should be judged objectively in terms of its efficiency. In the case of resource allocation the market could possibly result in an optimum allocation. However, the market is less efficient in the distribution of income. Three reasons were discussed as to why the market may fail as an allocator of water resources: (1) the existence of technological interdependencies; (2) the existence of indivisibilities; and (3) the existence of public goods. A discussion followed on how to evaluate the alternative forms of water resource allocation. A national society would evaluate returns relative to costs in deciding the optimum level of water use and would consider and choose on the basis of cost from alternative ways of supplying that level of use. Three topics were discussed to illustrate the basis on which alternatives would be chosen: (1) water quality (pollution) (2) water diversion, and (3) recreational values. (Grossman-Rutgers)
W68-01111

THE CURRENT FEDERAL PROGRAM FOR RIVER BASIN PLANNING AND THE NEED FOR ECONOMIC ANALYSIS,
U. S. Dept of Agriculture, Economic Research Service, Wash, D C.
William A. Green.
Institute of Food and Agricultural Sciences, The University of Florida, Water Research Needs: An Economic Appraisal, Pub No 3, pp 19-33, Dec 1967. 15 pp, 1 map, 3 ref.

Descriptors: *Water resources development, Federal Government, Grants, Economic feasibility, *Regions.
Identifiers: Economics, *Planning.

The current Federal Government program of river basin planning had evolved into a comprehensive activity. Such activity would consider all aspects of the water resources situation under study. The current emphasis on comprehensive river basin planning was traced to the report of the Senate Select Committee on Water Resources. From this report two types of planning resulted: (1) regional studies of water resource problems, needs, and general approaches to development; and (2) mo detailed studies of selected sub-basin areas, a maj objective of which is to identify projects to satis immediate and short-term needs for water develo ment. Various aspects of policy implementatio financing, and arrangements were discusse Finally, the issue that the full application economic analysis in the planning process was conflict with the traditions of water resourc planning, was examined. (Grossman-Rutgers)
W68-01113

THE IMPORTANCE OF RESEARCH AN PLANNING IN WATER RESOURCE DEVELOI MENT,
Water Resources Council, Wash, D C.
Harry Steele.
Institute of Food and Agricultural Sciences, Th University of Florida, Water Research Needs: A Economic Appraisal Pub No 3, pp 8-18, Dec 196 11 pp, 5 fig, 1 map.

Descriptors: *Water resources developmen Grants, Federal Government.
Identifiers: Economics, *Planning.

The development and organization of the Federall financed Water Resources Council was discussed The Council was organized and financed by th Water Resources Planning Act of 1965. The Coun cil's comprehensive plans that are supposed t cover the United States by 1972 were included Also included were the Council's objectives of th national assessment for present and projected con ditions in each river basin. Several organizationa charts and a map of proposed water resource re gions for comprehensive surveys were included i the report. (Grossman-Rutgers)
W68-01114

ECONOMICS IN WATER RESEARCH,
Chicago Univ., Chicago Department of Economics
G. S. Tolley.
Institute of Food and Agricultural Sciences, Th University of Florida, Water Research Needs: A Economic Appraisal, Pub No 3, pp 34-40, Dec 1967. 7 pp.

Descriptors: Cost-benefit analysis, *Water de mand, *Prices, Planning, Political constraints Forecasting, Waste water (Pollution).
Identifiers: Economics, Water resource develop ment.

In planning water demand studies it was useful t consider four attributes of water demand: (1) de mand for a water quantity to take in; (2) demand for a water quality to take in; (3) demand to get ri of a quantity of water effluent; and (4) demand t get rid of the effluent in a certain quality state Usually, in most cost-benefit analysis, wate planning, and other projections, current price have been used. Difficultto-quantity benefits coul be measured in dollar terms by considering mone as a common denominator and marginal rates o substitution. When estimating the national benefit of regional development the preference of in dividual's should be quantified and included in th cost-benefit analysis. There is a definite need fo inter-disciplinary research which includes th physical and the social sciences. There are tw types of water planning problems: (1) problems o rivers which used to have adequate supply of water and (2) problems of long-distance interrelations (Grossman-Rutgers)
W68-01115

INTERIM APPRAISAL OF OKLAHOMA BASINS PROJECT, OKLAHOMA: WATER THE KEY TO OKLAHOMA'S FUTURE.
U. S. Bureau of Reclamation, Denver, Colo.

U S Bur of Reclam, Denver, Colo, pp 1-9, A1-A4 B1-B15, C1-C10, D1-D14, E1-E8, Feb 196 (revised edition). 60 p, 8 fig, 8 tab, 5 append.

Descriptors: *Water resources development, *Inter-basin transfers, *Planning, *Water requirements, *Water sources, Multiple-purpose projects, Oklahoma, Groundwater, Surface waters, Data collections.
Identifiers: Oklahoma water plan.

Oklahoma's needs for water are described, future demand is projected, and a comprehensive water plan to meet demand is presented. The survey of requirements involves analysis of historic data on population and employment, a canvass of basic industries for water use and employment, a canvass of municipal and private water systems, an analysis of resources and industrial potential, a projection of employment trends and population trends, and calculation of water use for these projections. Projections were made from 1960 to 2080, and the results are tabulated. The total projected demand is 6,267,000 acre-ft of water per yr of which 5.54 million is in the western 2/3 of the state. The present supply available in the eastern 1/3 of the state is 6,900,000 acre-ft per yr. Thus, a redistribution plan is recommended and described in detail. (Knapp-USGS)
W68-01131

THE ANIMAL FARM: A MATHEMATICAL MODEL FOR THE DISCUSSION OF SOCIAL STANDARDS FOR CONTROL OF THE ENVIRONMENT,
Harvard University, Cambridge, Mass.
Harold A. Thomas, Jr.
J Amer Water Works Ass, Vol 56, No 9, pp 1087-1091, Sept. 1964. 5 p.

Descriptors: Discount rate, Economic efficiency, *Environmental engineering, Estimated benefits, *Intangible benefits, Intangible costs, *Mathematical models, Probability, *Social values, Value engineering, *Cost-benefit ratio, Comparative benefits, Welfare (Economics), Legislation, Environmental effects, Utilities.
Identifiers: Present value.

A mathematical model was derived for determining the critical level of pathogen density in some stock animals' drinking water. The present value of the revenue stream obtained by selling the expected number of surviving animals per year that drank untreated water, was equated to the present value of the annual full-herd sale minus the cost of water treatment. The decision of treat or not treat was based on a cost-benefit ratio made possible by the explicit value placed on the animals. This example was used to illustrate that all social standards such as speed limits and air and water pollution standards place an implicit value on human life, health, well-being, safety or aesthetics. It was suggested that general models be constructed, and applied to areas of environmental management where criteria have already been established to quantify some of our social values. This would aid in establishing norms and ranges for quality criteria and standards.
W68-01157

A STUDY IN THE ECONOMICS OF WATER QUALITY MANAGEMENT,
U. S. Department of the Interior, Washington, D. C.
For primary bibliographic entry see Field 05G.
For abstract, see .
W68-01165

PRESENT USES AND WATER ECONOMY.
Arizona Interstate Stream Commission, Phoenix.

In Report Ariz Water Res, Chapter II, PP 32-41, Oct 1967. 8 tab, 1 p.

Descriptors: Economics, *Water utilization, Irrigation programs, *Irrigated land, Overdraft, Groundwater, Agriculture, Benefits, *Water requirements, Industrial water, Municipal water, Indian reservations, Surface waters, *Water supply, Recreation demand, Water shortage, Hydrologic data.
Identifiers: Irrigation agriculture.

The Arizona Interstate Stream Commission conducted a study of Arizona's water resources. Present uses and economy of water were discussed. In 1961, of the total 1,460,430 acres developed as irrigated lands only 1,257,150 were actually utilized employing approximately 5.5 million acre feet of water. Municipal and industrial water requirements were an estimated 400,000 acre feet per year. A total of 200,872 acres of irrigated land were located on reservation land which encompassed 21.5 million acres. Water-based recreation has been limited due to the 214,000 acres of water surface. Total groundwater pumpage approaches 5 million acre feet annually. This includes a 3 million overdraft. Consumption was estimated at the rate of 7.6 million acre feet of which one third is irrevocably lost from the groundwater bank. (Affleck-Ariz.)
W68-01182

PLANNING FOR WATER RESOURCE DEVELOPMENT.
Arizona Interstate Stream Commission, Phoenix.

In Report, Ariz Water Res, Chapter V, pp 52-74, Oct 1967. 23 p, 1 tab.

Descriptors: *Water resources development, *Future planning (Projected), *Water management (Applied), Administration, Reclamation, *Evaporation control, Weather modification, Water reuse, Watershed management, Water quality, *Brush control, Channeling, Agriculture, Arable land, *Beneficial use, Project planning.
Identifiers: *Central Arizona Project.

The Arizona Interstate Stream Commission conducted a study of Arizona's water resources. Planning for water resource development was discussed, the most immediate potential being the Central Arizona Project. An average cash flow deficit throughout a 50 year payout period ranged from 7 million to 36 million dollars per year. At the end of this period a net cash flow yield by the project to the state was estimated from 20 to 30 million dollars per year. Other management programs discussed included Kingman Project, Mogollon Mesa Project, Black River-Springerville-St Johns Project, Prescott-Verde Project, Snowflake Project, Water Research and Salvage programs and use of canal linings and sealants, evaporation reduction, weather modification and wasteland reclamation and management, water shed management, water quality and water salvage desalting, phreatophyte control and channelization programs. It was estimated 9 million acres more of arable land in Arizona could be utilized for agriculture by means of irrigation. (Affleck-Ariz)
W68-01185

PUBLIC RIGHTS IN WATER USES AND PRIVATE RIGHTS IN LAND ADJACENT TO WATER - DIV A: TRADITIONAL RIGHTS OF THE PUBLIC IN WATER USES,
For primary bibliographic entry see Field 06E.
For abstract, see .
W68-01288

PUBLIC RIGHTS IN WATER USES AND PRIVATE RIGHTS IN LAND ADJACENT TO WATER - DIVISION B: PRIVATE RIGHTS IN LAND ADJACENT TO WATER,
For primary bibliographic entry see Field 06E.
For abstract, see .
W68-01289

CLASSES OF WATER AND CHARACTER OF WATER RIGHTS AND USES - SECTION 53: NATURE OF PROPERTY RIGHTS IN WATER,
For primary bibliographic entry see Field 06E.
For abstract, see .
W68-01292

CLASSES OF WATER AND CHARACTER OF WATER RIGHTS AND USES - SECTION 54: BENEFICIAL AND REASONABLE USES OF WATER,
For primary bibliographic entry see Field 06E.
For abstract, see .
W68-01293

WATER ECONOMICS: RELATIONS TO LAW AND POLICY,
For primary bibliographic entry see Field 06E.
For abstract, see .
W68-01295

(THE NEED FOR A NATIONAL WATER POLICY),
For primary bibliographic entry see Field 06E.
For abstract, see .
W68-01301

THE GREAT LAKES WATER RESOURCE,
For primary bibliographic entry see Field 05C.
For abstract, see .
W68-01305

WATER RESOURCES PLANNING.

42 USCA Sec 162-162d-11, pp 9-26, (1967 Supp). 18 p (79 Stat 244).

Descriptors: *Water Resources Planning Act, *Legislation, *Grants, *River basin commissions, Water resources, Administrative agencies, Administration, Federal Government, State governments, Planning, Long-term planning.
Identifiers: *Water Resources Council.

Congressional policy is to provide for the conservation, development and utilization of water on a comprehensive and coordinated basis. The Water Resources Council is established and its composition set. It is to maintain a continuing study of the adequacy of water supplies and the relation of various programs to each other; and established principles and standards for federal programs. It is to review the plans of river basin commissions. Provisions are made for the operation of the Council. The establishment of river basin commissions and their membership are provided for. The commissions are to engage in such activities and pursue such studies as to carry out the purposes of the act. They are to submit a comprehensive plan for water and related land resources in their areas, and suggestions for implementation thereof. Provisions are made for the operation of the commissions, and for compensation of members. Grants to states are authorized to the states to assist in their participation, and conditions and procedures are set forth. Special provisions are made for the Northeastern United States and the Delmarva Peninsula. (R. F. Williams-Fla)
W68-01307

A FOUR STATE COMPARATIVE ANALYSIS OF PUBLIC RIGHTS IN WATER,
Dept of Law, University Extension, U of Wisconsin, Madison.
G. Graham Walte.
A Four State Comparative Analysis of Public Rights in Water pp 1-32, June 15, 1967. 32 p, 130 ref.

Descriptors: *Minnesota, *Wisconsin, *Indiana, *Ohio, Ownership of beds, Riparian rights, *Public rights, Navigable waters, Recreation, Fishing, *Navigation, Casements, *Relative rights, *Water rights, Water utilization.
Identifiers: Private water rights, State trust doctrine.

Public rights in water in Minnesota, Wisconsin, Indiana and Ohio are compared. The uses generally included in public rights are navigation, fishing, and other activities principally recreational in nature. Rights in water are divided between rights held only by riparians (private rights) and rights

held by riparians and nonriparians alike (public rights). The law protects private rights to the reasonable use of water abutting riparian land by declaring them to be property rights subject to legal protection. Public rights are protected by declaring the ownership of beds of waterbodies to be held by the state in trust for the people, or by establishing an easement over the beds for all uses recognized in nonriparians. The validity and usefulness of the public rights-private rights distinction is questioned. Public rights are created by both the courts and the legislatures. In Indiana public rights are created by the legislature, and viewed as police regulations. The significance of the sources of public rights is discussed. Public rights exist in waters which are navigable in fact. Generally all legitimate recreational uses of water are within the public right. (Kirkconnell-Fla)
W68-01310

THE HOOVER REPORTS ON WATER RESOURCES AND POWER -- A COMMENTARY,
Albert W. Stone.
Calif L Rev, Vol 43, No 2, pp 747-765, Dec 1965. 19 p, 102 ref.

Descriptors: Administrative agencies, Hydroelectric power, Federal Power Act, Federal government, Water resources planning, Future planning, Economic justification, Water resources development, Federal jurisdiction, Public utilities.
Identifiers: Hoover Reports.

The author examines the scope, methods of analysis, and recommendations of the second Hoover Commission reports on Water Resources and Power. He finds that research for this report was needed to clarify and bring to the forefront many of the issues confronting the nation. Much of the material in the reports involves impressive studies and discussions of particular aspects of resource problems. However many of the policy oriented conclusions and recommendations are poorly supported by background analysis. Specifically he finds that: (1) the recommendations fail to offer sufficient guidelines and leave the 'streamling' problems entirely to the Water Resources Board; (2) the premises for the conclusions are not well grounded; (3) in some areas the supporting arguments are not persuasive; (4) the conclusions seem to have been formed before the supporting arguments. Most of the criticisms deal with the method of arriving at conclusions rather than evaluating the conclusions themselves. (Kirk-Fla)
W68-01311

POLICIES FOR WATER LAW: PROPERTY RIGHTS, ECONOMIC FORCES, AND PUBLIC REGULATION,
Wyoming Univ School of Law, Laramie.
Frank J. Trelease.
Natural Resources J, Vol 5, No 1, pp 1-23, May 1965. 24 p, 77 ref.

Descriptors: *Water policy, *Welfare (Economics), *Water law, Water resources development, *Economic evaluation, Cost-benefit analysis, Long-term planning, Multiple-purpose projects, Water utilization, Competing uses, Comparative benefits, Preferences (Water rights), Intangible benefits, Recreation.
Identifiers: *Maximization principle.

The author begins by setting out the personal credo behind his preferences in water policies: water law should provide for maximum benefits; and the means to this end should be the granting of private property rights in water, secure to encourage development, flexible enough to be beneficially changed by economic forces, and subject to public regulation only when public interests are not protected. The ultimate general goal for water resources law is expressed in economic terms as the maximization principle of obtaining the largest net social return from the use of a resource. However, there is no formula for ascertaining when the maximization has been or will be reached. The suggested means for achieving the maximization goal are property, economics, and regulation. An ideal water law should give a water right characteristics that will encourage and enable people to make the best decisions as to water use in their own interests and hence in the public interest. A water regulatory agency attempting to apply the maximization principle may find the economists cost-benefit analysis to be useful, even when dealing with intangibles like recreation. (Patterson-Fla)
W68-01312

POLICIES FOR WATER LAW: PROPERTY RIGHTS, ECONOMIC FORCES, AND PUBLIC REGULATION,
Wyoming Univ School of Law, Laramie.
Frank J. Trelease.
Natural Resources J, Vol 5, No 1, pp 23-48, May 1965. 26 p, 65 ref.

Descriptors: *Water policy, *Water rights, Economic evaluation, Welfare (Economics), Water utilization, Competing uses, *Regulation, Public benefits, Water resources development, Long-term planning, Comparative benefits, Preferences (Water rights).
Identifiers: *Public interests.

Policies and principles that should govern the duration and description of the water right are analyzed. Economic forces affecting changes in water use are discussed as they relate to the choice between two methods of giving water use rights: flexible rights, and secure but transferable rights. The author believes that in order to realize the welfare principles, as well as maximum dollar values, the law should grant a firm, secure right. In making a change from private to public use, compensation for the owner is urged as the most desirable method, unless the use was in the nature of a subsidy. Public regulation is only needed when the question of what is good for the individual relates to persons not in a position to otherwise affect the decision. Defects in the free market system that call for public regulation are set forth. The common denominator of all reasons for public regulation is that in each case unregulated private activity will permit the water user to shift or impose some of the costs to other persons or on the public. Devices for protecting public interests are presented, and general conclusions are set forth. (Patterson-Fla)
W68-01313

MULTIPLE LAND USE MANAGEMENT,
Warren A. Starr.
Natural Resources J, Vol 1, No 2, pp 288-301, Nov 1961. 14 p, 27 ref.

Descriptors: *Land use, *Multiple purpose, *Watershed management, *Land management, Soil conservation, Conservation, Tennessee Valley Authority.
Identifiers: Multiple use management, U S Forest Service.

Multiple land use means management of land in a manner that, while preserving the land resource itself, insures high productivity in line with land potential. Lack of public concern, limited or selected land use, competition for products, and the need for a system of appraisal and evaluation are discussed as hinderances to the operation of the multiple land use concept. The conclusion contains proposals for the application of multiple use on a watershed basis: (1) upgrading of data gathering process; (2) research and field investigations in quest of proper kind of individual land unit most completely reflecting ecologic, hydrologic and structural potential; (3) creation of management or administrative units for distributed multiple use based on land potential; (4) allowance for single, alternate, or multiple use choice of single tracts to be decided upon competitive comparison of single tract potentials; (5) use and productivity potential to have more impact on land use decisions; (6) proper concept of multiple use to include management for water production. (MacMillan-Fla)
W68-01319

RELATIONSHIPS BETWEEN WATER AND OTHER PROPERTY RIGHTS AND SMALL WATERSHED DEVELOPMENT IN THE EASTERN STATES,
For primary bibliographic entry see Field 04D.
For abstract, see .
W68-01325

STATE DISTRICT LAWS AS THEY AFFECT WATERSHED DEVELOPMENT,
For primary bibliographic entry see Field 04D.
For abstract, see .
W68-01326

MODEL WATERSHED DISTRICT ACT,
For primary bibliographic entry see Field 04D.
For abstract, see .
W68-01327

THE ROLE OF ECONOMIC EVALUATION IN PLANNING FOR WATER RESOURCE DEVELOPMENT,
Allen Kneese, and Kenneth C. Nobe.
Nat Res J, Vol 2, No 3, pp 445-482, Dec 1962. 38 p, 51 ref.

Descriptors: *Economics, Economic efficiency, Cost-benefit analysis, Decision making, Marketing, Resource allocation, Social aspects, Value engineering, Water demand, Simulation analysis, Discount rate, Administrative agencies.

Economic reasoning plays an important role in resolving problems of socio-economic choice encountered in planning for water resources development. Unique characteristics of water quality any application of simply valuation models to water as an economic commodity. Pollution abatement is used to illustrate the uses and weaknesses of a valuation model approach. A constrained objective function is suggested as a useful framework for incorporating public goals. Maximizing an objective in a practical situation makes great demands upon concepts, date and problem solving abilities. Simulation and mathematical programming are discussed as procedures for approximating optimum systems. The authors suggest a relationship between economic function and the choice of administrative forms for water management. (MacMillan-Fla)
W68-01332

THE STATE V THE RIPARIAN: A PROBLEM OF WATER USE AND CONTROL.
For primary bibliographic entry see Field 06E.
For abstract, see .
W68-01333

SOME PHYSICAL, TECHNOLOGICAL, AND ECONOMIC CHARACTERISTICS OF WATER AND WATER RESOURCES SYSTEMS: IMPLICATIONS FOR ADMINISTRATION,
Blair T. Bower.
Nat Res J, Vol 3, No 2, pp 215-238, Oct 1963. 23 p, 10 fig, 32 ref.

Descriptors: *Water resources development, Water utilization, *Optimum development plans, *Project planning, *Administration, Reservoir operation, Hydrologic cycle, Water management (Applied), Water properties, Structures, Surface-groundwater relationships.

Water resources administration, or manipulation of developed supplies rather than development of new supplies will be the major future task. Water resources administration falls into three general categories: (1) deciding what facilities and related operations should be constructed; (2) construction; (3) operation. A water resources system is a configuration of structural and non-structural measures and operating procedures which transforms

the raw material, water, into outputs of water and water-related products and services. Characteristics of water which should influence organizational structure for water resources administration are: (1) surface water and ground water are integrally related physically; (2) quality is inseparable from quantity; (3) the areal focus varies among the different outputs of a water resources system; (4) local level development affects regional or basin development; (5) water supply and demand are uncertain; (6) economies of scale exist in the production of water related products; (7) outputs are somewhat complimentary; (8) integrated operation of reservoirs, and of reservoirs and related non-structural measures provide economies; (9) planning of systems is related to their design and operation; (10) outputs vary in marketability. Reasons for these characteristics and implications thereof are discussed. (R. F. Williams-Fla)
W68-01341

QUESTIONS FOR DESIGNERS OF FUTURE WATER POLICY,
Edward A. Ackerman.
Journal of Farm Economics, Vol 38, No 4, pp 971-980, 1956. 9 p.

Descriptors: *Water policy, *Water resources development, *Future planning (Projected), Legislation, Administration, Administrative agencies, Federal government, Environment, Geographical regions, Technology, Regions, Regional analysis, Data collections, Human population.

One of the first problems with considering policy recommendations of an economic nature has to do with the definition of the policy. It may be a stable body of principles to quick water resources development. Such a formulation of water policy has not been achieved despite activity in this area. One reason for a lack of clear policy is the actions of special interest groups. To arrive successfully at a national water policy it is necessary to consider the environment surrounding the policy, including underlying forces. Two examples of forces are the geographical environment and technology. Inherent in the former is a need for a better compilation of physical data. Another aspect of the geographical environment is the need to organize development programs on a regional basis. Technological changes should be viewed in light of centralization and decentralization of planning, management, etc. Other factors to be considered are population and the national defense. One necessary step in effectuating a stable water policy is to differentiate between policy and procedure. Policy should concern itself with broader principles than procedure, the underlying forces rather than the settlement of conflicts between dissident interests. (Breuel-Fla)
W68-01343

WATER RESOURCES PLANNING IN THE SOUTHEASTERN UNITED STATES,
Institute of Law and Government, School of Law, U of Georgia, Athens.
For primary bibliographic entry see Field 06E.
For abstract, see .
W68-01358

WATER PURITY: A STUDY IN LEGAL CONTROL OF NATURAL RESOURCES,
For primary bibliographic entry see Field 06E.
For abstract, see .
W68-01361

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

INCOME REDISTRIBUTION EFFECTS AND BENEFIT-COST ANALYSIS,
Burton A. Weisbrod.
Problems in Public Expenditure Analysis, edited by Samuel B. Chase, Jr. pp 177-209, The Brookings, Institution, Washington, D. C., 1968. 33 p, 7 tab, disc.

Descriptors: *Efficiencies, Equitable apportionment, *Benefit-cost ratio, Water resources development, Administrative costs, Welfare, *Decision making, *Project planning, Age, Geographical regions, Income.
Identifiers: Allocative efficiency, *Income redistribution, Secondary effects, Psychic effects, *Distributional weights, Racial.

This paper concentrates on the proper role of distributional considerations in a benefit-cost framework. To date, the valuation of distributional effects of public expenditure programs has eluded economists. Even if these effects cannot be evaluated their importance necessitates a discussion of the forms of redistributive effects. We are urged to greater efforts to develop weights for various groups so that benefits of a distributional sort can be integrated with those of a real sort. If the willingness to sacrifice efficiency for redistribution was indicated, planners would formulate designs to maximize a weighted sum of redistribution and efficiency. This weighted sum is termed the grand efficiency, and the opportunity costs are the indicators of relative importance of a marginal dollar to each group involved. One approximation of this goal would be to determine and then display how the total benefits of each project would be divided among the various population groups. Another method presented would deduce the value judgments concerning the distribution of income that are implied by decision-makers choices. This would focus attention on their ethical acceptability and may aid in forecasting government expenditure decisions. (Seneca-Rutgers)
W68-01050

A STUDY IN THE ECONOMICS OF WATER QUALITY MANAGEMENT,
Federal Water Pollution Control Administration, U.S. Department of the Interior, Washington, D. C.
For primary bibliographic entry see Field 05G.
For abstract, see .
W68-01051

A SOCIALLY OPTIMUM PRICING POLICY FOR A PUBLIC WATER AGENCY,
Washington Univ., Seattle; California Univ., Berkeley.
Gardner Brown, Jr., and C. B. McGuire.
Water Resources Research, Vol 3, No 1, pp 33-43, First Quarter 1967. 11 p, 5 tab, 12 ref.

Descriptors: Surface waters, Groundwater, Profit, *Welfare, Water rates, Water costs, Tax rate, *Irrigation districts, Water demand.
Identifiers: *Steady-state, *Pricing policy, Externality, Lift levels, *Kern County Water Agency, Pumping costs, Private costs, Social costs.

A simple model is developed for determining the socially optimum price to charge locationally differentiated irrigation districts for both surface and groundwater supplies. Steady-state conditions are assumed for groundwater conditions and water demand functions. A divergence between social and private optimums arises from the existence of unadjudicated rights to groundwater supplies. The social optimum can be achieved by an appropriately conceived taxing policy. Water prices, tax rates, and optimum lift levels are estimated for seven irrigation districts, members of a master water agency. (Seneca-Rutgers)
W68-01057

TEMPORAL ALLOCATION OF GROUNDWATER,
Missouri Univ., Columbia.
Oscar R. Burt.
Water Resources Research, Vol 3, No 1, pp 45-56, First Quarter 1967. 12 p, 3 fig, 1 tab, 5 ref, 1 append.

Descriptors: *Groundwater, *Water allocation, Equilibrium, Use rates, Discount rate, Water values.
Identifiers: *Temporal allocation, *Decision rule, Optimal rate, Optimal decision, Groundwater storage, Recharge rate, Optimal policy.

A simple economic model for allocation of groundwater over time is developed. The economic consequences of altering various parameters in the model are examined with respect to the effect on equilibrium stocks and rate of use. The concept of a conditional decision rule for stochastic groundwater recharge and the properties of the implied equilibrium are discussed. In its simplest form, the derived decision rule is to equate marginal net output with respect to rate of use to capitalized marginal net output with respect to water stocks. (Seneca-Rutgers)
W68-01060

THE DYNAMICS OF PUBLIC ROLES IN THE SELECTION OF REVENUE SOURCES IN LOCAL WATER ADMINISTRATION,
Colorado State Univ., Fort Collins.
Charles L. Garrison, and Duane W. Hill.
Water Resources Research, Vol 3, No 4, pp 949-962, Fourth Quarter 1967. 14 p, 1 fig, 5 tab, 24 ref.

Descriptors: *Water utilization, *Political aspects, Water rates, Taxes, Administration, Occupations, Education, Income, Urbanization.
Identifiers: Public role, Revenue sources, Federal aid, *Socio-economic variables, *Attitudinal dimensions, Residence, Efficacy.

One of the largest voids in the information available to local decision-makers on water use is the knowledge of limits placed upon the policy-makers' opinions by their respective publics. Results from an effort to classify orientations toward debt-retirement policy alternatives of the public in a special rural-domestic water district demonstrated: (1) that persons who would grant flexibility in policy-making were lower social status newcomers with a low rate of political participation but a relatively high political efficacy, an urban outlook, high personal rigidity, and high deference toward authority; (2) that the restrictiveness of the resister (who comes primarily from the high income, participant-oriented, upper middle class) is probably a function of his ideological framework and a consistent level of activity that gives him high potential for limiting the policy-makers' decision-making options; (3) that the complaint medium is a viable component for measuring and classifying political behavior. (Seneca-Rutgers)
W68-01061

WATER COSTS.
Arizona Interstate Stream Commission, Phoenix.

In Report, Ariz Water Res, Chapter III, pp 42-45, Oct 1967. 4 p.

Descriptors: Water resources, *Water costs, Surface waters, Irrigation operation and maintenance, Groundwater, *Industrial water, Municipal water, Pumping, *Water rates.
Identifiers: Irrigation agriculture.

The Arizona Interstate Stream Commission conducted a study of Arizona's water resources. Water costs was dealt with in this chapter. The cost of irrigation varied greatly depending on many factors. Supplied water varied from $1 to $10 per acre foot where water was apportioned by shares. Estimations of groundwater costs varied from approximately $3 per acre foot for pumping lifts of 10 to 40 feet, to approximately $20 per acre foot for pumping lifts of 350 to 400 feet. Supply of water for municipal and industrial use ranged from less than 10 cents per thousand gallons in areas of optimum conditions to 50 cents per thousand gallons in areas of deprivation. Consumer prices would have then been 0.28 to 0.32 cents per thousand gallons and 0.42 to 0.68 cents per thousand gallons respectively. (Affleck-Ariz)
W68-01183

PROGRESS REPORT ON WEST TEXAS AND EASTERN NEW MEXICO IMPORT PROJECT INVESTIGATION.
U. S. Bureau of Reclamation.
For primary bibliographic entry see Field 03F.
For abstract, see .
W68-01271

TAX PROBLEMS RELATING TO WATER RIGHTS AND WATERWORKS - DIV A AND DIV B: INTRODUCTION AND PROPERTY TAX,
For primary bibliographic entry see Field 06E.
For abstract, see .
W68-01296

TAX PROBLEMS RELATING TO WATER RIGHTS AND WATERWORKS - DIV C: SPECIAL TAXES ON WATER AND ELECTRIC COMPANIES - DIV D: FEDERAL INCOME TAX PROBLEMS RELATING TO WATER RIGHTS AND H2O WKS,
For primary bibliographic entry see Field 06E.
For abstract, see .
W68-01297

THE ADMINISTRATION OF WATER LAWS IN FLORIDA,
Institute of Law and Government, College of Law, Georgia Univ, Athens.
John W. Wakefield.
In Water Law and Policy in the Southeast, pp 285-291, 1961. 7 p.

Descriptors: *Florida, *Administration, *Legislation, *Riparian rights, Reasonable use, Surface waters, Groundwater, Water law, Administrative agencies, Water policy, Water districts, Conservation, Water shortage, Surplus water.

Until recently, Florida strictly adhered to the modern riparian doctrine, with the reasonable use test. However, the riparian doctrine recognized no connection between surface and ground waters. Florida differs from much of the country in that it has an abundance of water, a groundwater flow related to surface water, a flat terrain, seasonal rainfall variations, and until recently, sparse population. These factors have influenced Florida's water laws. Legislative interest and action began in 1955 with a policy against private ownership of waters. In 1957, a study commission recommended new water legislation in Florida. A new law was embodied in the Water Resource Law of 1957. It permits a breach of the riparian doctrine by the State Board of Conservation when there is excess or shortage of water. Diversion is also covered. Water conservation districts have been sought by citrus grove owners and cattlemen. The author concludes that more legislation is necessary but the legal framework already exists.
W68-01356

CAN WATER BE ALLOCATED BY COMPETITIVE PRICES,
American Farm Economic Assoc., Menasha, Wis.
W. K. McPherson.
J of Farm Econ, Vol 38, No 5, pp 1259-1268, Dec 1956. 10 p, 3 ref.

Descriptors: *Water resources development, Hydrologic cycle, Water quality, *Economic efficiency, *Competing uses, Water rights, Prior appropriation, Riparian rights, Water utilization, Legislation, Water pollution, Water storage, Reservoir storage, Farm ponds, *Water rates, Groundwater, Multiple-purpose projects.

In this paper an effort is made (1) to establish a conceptual framework of evaluating the economic status of water, (2) to describe an economic environment that would facilitate the competitive pricing of facilities that would make water useful, and (3) to suggest the extent to which it may be possible to use competitive prices to allocate the cost of water-producing facilities. After examining the above points the author concludes that the possibility of using competitive prices to allocate utility in water varies in different segments of the hydrologic cycle. To maximize the use of competitive pricing of the rights to use water it will be necessary to satisfy as many of the requisites of a competitive environment as possible in each and every situation in which such facilities are scarce. Whether or not the scarce portions of the hydrologic cycle and the cost of erecting and operating facilities to expand them can be allocated in a more competitive economic environment depends primarily on the ability of human beings to define the rights to use such facilities.
W68-01383

COMMONALITY, THE PRICE SYSTEM, AND USE OF WATER SUPPLIES,
Jerome W. Milliman.
So Econ J, Vol 22, No 4, pp 426-437, Apr 1956. 12 p, 1 fig, 9 ref.

Descriptors: Economics, Decision making, *Cost allocation, Cost-benefit analysis, Tax rate, *Economic efficiency, Market value, *Water utilization, Pumping, Economic rent, Competing uses, Exploitation.

Greater reliance should be placed upon the price system to allocate water resources efficiently among competing uses and users. Most water supplies are exploited in common. Commonality of use prevents the burden of costs from falling on a particular pumper and causes a divergence of private and social costs. Commonality also prevents the acquisition of property rights to water so that water tends to be valued at its 'cost of production' instead of at its economic worth and economic rents fail to appear. Two solutions are possible which would destroy or mitigate commonality. The establishment of adjudicated quotas could prevent overdraft and salt water intrusion and assist in the rational valuation of supplies on the part of private users. The imposition of 'use' taxes to correct the divergence between private and social costs, the 'classical' solution, is the second alternative.
W68-01399

WATER LAW AND DECISION-MAKING: A CRITIQUE,
Chicago Univ. Law School.
J. W. Milliman.
Journal of Law and Economics, Vol II, pp 41-63, Oct 1959. 23 p, 34 ref.

Descriptors: Water rights, *Regulation, *Water utilization, *Marketing, *Preferences (Water rights), Riparian rights, Reasonable use, Prior appropriation, Usufructuary right, Real property, Appropriation, *Water allocation (Policy), Priorities, Water conveyance.

Regulation of water rights by the market process is viewed as preferable to control by a centralized agency. A market in water rights cannot operate, however, unless water rights are treated as a real property right, legally certain and fully transferable. The riparian doctrine and appropriation doctrine are the two prevailing water law systems in the U S. Neither fully provides the two requisites of legal certainty and transferability of rights. The riparian system is least suited for allocating water rights through the market process. Its reasonable use doctrine causes rights to vary with changing conditions. The doctrine of appropriation offers a framework for developing a market in water rights. The prior appropriation system provides a degree of legal certainty, but needs modification to permit free transferability. Suggested modification of the appropriation system that would contribute to greater utilization of water resources through market control are: (1) Permit transfer of use and users from the original ones to others; (2) Eliminate strict priorities and replace them with economic considerations. Instead of giving the senior appropriator complete priority in times of drought allocate water to the junior if his loss is greater; (The junior can compensate the senior for the loss covered by the diversion); (3) Eliminate forfeitures of water rights from non-use.
W68-01400

6D. Water Demand

FEATHER RIVER NEAR CHESTER, CALIFORNIA (FLOOD CONTROL).
U S Army Corps of Engineers, Wash, D. C. Office of Chief of Engineers.
For primary bibliographic entry see Field 04A.
For abstract, see .
W68-01037

THE IMPACT OF PRICE ON RESIDENTIAL WATER DEMAND AND ITS RELATION TO SYSTEM DESIGN AND PRICE STRUCTURE,
Resources for the Future, Inc., Washington, D. C., Dept. of the Interior, Washington, D. C.
Charles W. Howe, and F. P. Linaweaver, Jr.
Water Resources Research, Vol 3, No 1, pp 13-32, First Quarter 1967. 20 p, 5 tab, 23 ref, 1 append.

Descriptors: *Water demand, Pricing, Water rates, *Elasticity of demand, Domestic water, Design, Measurement, Sprinkling.
Identifiers: *Residential water demand, Spurious demand, Summer sprinkling demand, Maximum day sprinkling demand, Demand function.

This paper formulates models of residential water demand and estimates the relevant parameters from cross-sectional data. For the first time, it has been possible to differentiate not only between domestic (inside) and sprinkling uses but also among metered, flat-rate, septic tank, and apartment areas. The major findings are: (1) domestic demands are relatively inelastic with respect to price; (2) sprinkling demands are elastic with respect to price, but less so in the west than in the east; (3) maximum day sprinkling demands, so important to system design, are inelastic in the west but relatively elastic in the east. The findings indicate that the elasticity of total demand, which this and other studies have found to be about -0.4, is a weighted average of the domestic and sprinkling elasticities. Longer term adjustments to price are empirically investigated, and the role of demand functions in pricing and system design is discussed. The appendix points out that the use of household-time averages in regression analysis will not lead to homoscedasticity if the study areas contain different numbers of households or if the periods of observation are of different length. A method for overcoming this difficulty by weighting the observations is indicated. (Seneca-Rutgers)
W68-01053

WATER-ORIENTED OUTDOOR RECREATION,
U S Dept of Agriculture, Economic Research Service, Columbia, Mo.
Glenn A. Gillespie.
Institute of Food and Agricultural Sciences, The University of Florida, Water Research Needs: An Economic Appraisal, Pub no 3, pp 44-54, Dec 1967 11 pp, 3 tab, 3 ref.

Descriptors: *Recreation demand, Prices, Supply, Federal Government, *Income, *Regression analysis, Age, Schools (Education), Sampling, *Socio-economic factors.
Identifiers: Economics, *Recreation.

User fees for the use of water-oriented recreational facilities were considered an equitable method rather than to finance through general taxation. A demand model was formulated based on cluster sampling. Fourteen activities were considered in the analysis. Responses to questionnaires indicated that people with adequate incomes and leisure time were generally satisfied with their recreational choices. People sought their recreation as family groups. It was assumed that the demand for recreation was a major factor in the development of land and water resources. The model used included both quantitative and qualitative socio-economic fac-

tors. The net effects of qualitative characteristics were included in the regression model by the use of 'dummy' variables. The dependent variable was the number of annual recreation days. A discussion of the quantitative results and a conclusion were included. (Grossman-Rutgers)
W68-01112

FUTURE WATER REQUIREMENTS.
Arizona Interstate Stream Commission, Phoenix.

In Report, Ariz Water Res, Chapter IV, pp 46-51, Oct 1967. 6 p, 6 tab.

Descriptors: *Water requirements, *Future planning (Projected), Water resources, Population, *Irrigation programs, Indian reservations, Hydrologic data, Recreation demand, Agriculture, *Water demand, Industrial water, Municipal water, *Water supply, Wildlife management, Water utilization, Domestic water.

The Arizona Interstate Stream Commission conducted a study of Arizona's water resources. Future water requirements were discussed. Increased growth of population and development of irrigation of Indian reservations would place increased demand on Arizona's water supplies. The population of the hydrologic study area was 1,302,000 in 1960. The projected population in 2020 was 9,727,000 for the same area. Water requirements in 1960 were 386,550 acre feet per year. The additional requirement in 2020 was estimated to be 2,011,071 acre feet per year. Proposals also were made for increased water-based recreation in the Phoenix-Tucson area. The state's total water demand for 2020 was reasonably estimated to be 13.7 million acre feet per year. (Affleck-Ariz.)
W68-01184

CLASSES OF WATER AND CHARACTER OF WATER RIGHTS AND USES - SECTION 55: QUANTITY AND QUALITY OF SUPPLY,
For primary bibliographic entry see Field 06E.
For abstract, see .
W68-01294

(THE NEED FOR RECONSIDERATION OF THE NAVIGATION SERVITUDE),
For primary bibliographic entry see Field 06E.
For abstract, see .
W68-01299

(THE FEDERAL PROPRIETARY POWER IN WATER RIGHTS).
For primary bibliographic entry see Field 06E.
For abstract, see .
W68-01300

LAND USE IMPLICATIONS OF SURFACE WATER ALLOCATION, CH 1 AND 2,
Vernon Edward George.
U of N Carolina Water Resource Papers, No 16, pp 1-25, May 1966. 25 p, 47 ref.

Descriptors: *Water allocation (Policy), *Administration, *Competing uses, Administrative agencies, Riparian rights, Prior appropriation, *North Carolina.
Identifiers: *Stream classification, Unregulated market, Public market intervention, River basin classification.

Chapter 1 identifies the basic problem as arriving at a method of allocation of limited water resources among competing users, and states that the considerations influencing such allocation should be: physical development, economic, political-administrative, and social. Chapter 2 discusses three basic types of water allocation, each with two subgroups. None are mutually exclusive. First the traditional doctrines of water rights, riparian rights and prior appropriation are discussed. Next, stream classification is discussed. One sub-type is river basin classification, where the stream basin as a whole is studied to determine the water quality which should be maintained along each part of the stream, and users are required to adjust their usage accordingly. Second is stream specialization where, in an area served by more than one stream, certain functions are assigned exclusively to one stream. The allocation technique of market control is broken up into (1) unregulated market control, entirely dependent on the price system; and (2) public market intervention, where an agency expertly guides water allocation to maximize the public interest. Problems and methods of valuation of water are discussed, and North Carolina is briefly referred to. (R. F. Williams-Fla)
W68-01308

LAND USE IMPLICATIONS OF SURFACE WATER ALLOCATION, CH 3 AND 4,
Vernon Edward George.
U of N Carolina Water Resource Papers, No 16, pp 26-38, May 1966. 13 p, 14 ref.

Descriptors: *Water allocation (Policy), *Competing uses, *Land use, Community development, Urbanization, Riparian rights, *Administration, Prior appropriation, Land development, Administrative agencies.
Identifiers: Stream classification, River basin classification, Stream specialization, Unregulated market control.

Predictions are made as to the effect that each of six water allocation techniques on the four land use variables: Density of development, shape of development, composition of use, and composition of social class. Density is the number of people per unit of built up land area. Shape of development refers to the physical form of the urban land uses, ie, linear or circular. Composition of use refers to degree of juxtaposition of distinct types of land use. Where commercial, residential, and industrial, recreation, and agricultural uses congregate separately, the composition of use is homogeneous. Where they locate together, it is heterogeneous. Composition of social class may also be homogeneous or heterogeneous depending upon whether the socio-economic classes locate in a separate or mixed pattern. The hypothetical implications to, and effects on, each of these land uses which would result from the choice of any water allocation technique are indicated, with explanation. Other influential factors are assumed to remain constant. It is concluded that any water allocation technique will be a highly influential factor in the character of land use. Further research is recommended. (R. F. Williams-Fla)
W68-01309

AN ECONOMIC VIEW: WATER PROBLEMS - NATIONAL AND REGIONAL,
J. N. Duprey.
North Dakota L Rev, Vol 38, No 2, pp 233-242, April 1962. 9 p, 2 tab, 17 ref.

Descriptors: Planning, Economic efficiency, *Water supply, *Water utilization, *Consumptive use, Non-consumptive use, *Missouri River, Water allocation (Policy), Competing uses.
Identifiers: *Net consumption.

This article is a review of our present and perspective water situation. The fresh water supply is derived from precipitation which in the long run, averages 30 in. per year in the US. 21 inches evaporates, leaving 9 in. to become runoff, available for use. Two general water use categories are withdrawal and flow. Net consumption is the difference between the amount withdrawn and the amount returned. A table shows net consumption for withdrawal uses is 37 percent. Flow uses involve power generation, fish conservation, recreation, and waste dilution. The ratio of net consumption to total runoff varies from the most favorable in the Pacific Northwest, to the least favorable in the South Pacific Basin, with the Upper Missouri Basin falling in the middle. Besides shortage problems, quality problems such as pollution are very important. The Select Committee on National Resources and its findings are discussed. Although projections of water use in 1980 and 2000 are well below the available water supply, it is pointed out that in certain areas, including the Upper Missouri Basin, this will not be true and there will be a serious water problem. Constructive action to help avert these problems is outlined. (R. F. Williams-Fla)
W68-01318

WATER MUSHROOMING POPULATIONS,
Clyde O. Martz.
West Va L Rev, Vol 62, No 1, pp 1-67, Dec 1959. 68 p, 288 ref.

Descriptors: Water shortage, *Water utilization efficiency, *Water consumption, *Water conservation, State governments, *Federal government, *Appropriation, Riparian rights, West Virginia, Northeast U S, Federal project policy, Federal-state water rights conflicts, Federal reclamation law, Reasonable use.
Identifiers: Non-riparian interests.

Part I evaluates water allocation theories to consider obstacles to full use of limited resources arising out of them. Substitution of a rule of reasonable use applicable to riparians and non-riparians alike may be the best way to avoid wastes. Constitutional problems are raised by substantive changes in water doctrine. Individuals who suffer special losses because of limitations placed in the public interest should be compensated. Part II explores technological devices for conserving water and legal problems to be resolved before their utilization. The need is great for policies to restore water supplies to suitable purity, for programs to store water from wet to dry seasons, for interstate compacts permitting water allocations for regional needs unlimited by state lines and for organizational patterns that can encourage engineering improvements in water distribution. Part III considers the role of the federal government in basin development. Private rights and legitimate state interests are threatened by the public welfare emphasis that is inherent in any significant water conservation and utilization program. Four recommendations for restoring the federal government to its proper role of stimulation, cooperation and assistance with private interests and States conclude the article. (MacMillan-Fla)
W68-01344

STATUTES FOR ADMINISTERING WATER USE IN THE SOUTHEAST,
Institute of Law and Government, School of Law, Georgia Univ., Athens.
For primary bibliographic entry see Field 06E.
For abstract, see .
W68-01350

WATER USE LAW IN ACTION,
Institute of Law and Government, College of Law, U of Georgia, Athens.
For primary bibliographic entry see Field 06E.
For abstract, see .
W68-01354

REGULATION OF WATER USE IN LOCAL AREAS BY STATE OR LOCAL GOVERNMENTS AND DISTRICTS,
Institute of Law and Government, College of Law, Georgia Univ, Athens.
For primary bibliographic entry see Field 06E.
For abstract, see .
W68-01355

WATER RESOURCES RESEARCH PROGRAM.

42 USCA Sec 1961-1961c-6, pp 16-24, 1964. 9 p (78 Stat 329).

Descriptors: *Legislation, *Administrative agencies, Administration, Federal Government, State governments, Water resources, *Grants, Water resources development, *Water Resources Research Act, Colleges, Universities.
Identifiers: Secretary of the Interior.

Congressional purpose is to assure a supply of water sufficient in quantity and quality to meet the nation's needs. Appropriations are made to allow each state to establish a water resources research institute at a state college or university. Duties of the institutes are to engage in competent research and to train scientists. Matching funds are provided for non-federal contributions. Criteria for awarding grants are set out. Provisions are made for the payment and handling of funds. Responsibility for administration is placed with the Secretary of the Interior, and he is granted rule making authority. Grants are authorized for other desirable projects not already being studied, and which are related to the mission of the Department of the Interior. Cooperation is directed with all agencies and groups to avoid duplication of research and to emphasize neglected areas. Advance payments are authorized and it is stipulated that the results of any research under this act must be made available to the public. A cataloging center is to be established for receipted of current and projected research in all fields of water resources. (Williams-Fla)
W68-01371

TRANSFER OF RIPARIAN RIGHT TO USE WATER TO NONRIPARIAN LAND.
Lawyers Co-op, Rochester, N. Y.; Bancroft-Whitney Co., San Francisco, Calif.
For primary bibliographic entry see Field 06E.
For abstract, see .
W68-01372

SOME ECONOMIC ISSUES IN WATER RIGHTS,
American Farm Economic Assoc., Menasha, Wis.
S. V. Ciriacy-Wantrup.
J of Farm Econ, Vol 37, No 5, pp 875-885, Dec 1955. 11 p, 28 ref.

Descriptors: *Prior appropriation, Groundwater, Surface waters, *Riparian rights, Prescriptive rights, Recreation, Water rights, Priorities, Storage capacity, Economic efficiency, Multiple-purpose projects, Irrigation water, Groundwater-surface relationships, Reasonable uses, Legislation.

Economic change poses the issues of institutional lag and of flexibility versus rigidity. At the present juncture, these economic issues in water rights are acute in four important problem areas. First, in the riparian-doctrine states of the East, increasing consumptive use of water has started a movement toward new water laws favoring appropriation. Second, in the appropriation-doctrine states of the West, increasing industrialization urbanization, and recreational uses have led to changes in water demand. These changes have raised the question of whether or not the appropriation doctrine, with its emphasis on first in time, first in right, may entail rigidities in favor of irrigation demand. Third, the great increase in the use of ground water during the last generation has called attention to difficulties of applying either the riparian or the appropriation doctrine, both of which were developed primarily in connection with surface waters. Fourth, modern engineering and large publicly financed multiple-purpose projects have increased the export of water from one watershed into another.
W68-01382

WATER LAW AND PRIVATE DECISION-MAKING: A CRITIQUE,
Chicago Univ.
J. W. Milliman.
J L and Economics, Vol 2, pp 41-63, Oct 1959. 23 p, 34 ref.

Descriptors: *Riparian doctrine, *Prior appropriation, *Competing uses, *Marketing, Priorities, Hydrologic cycle, Natural flow doctrine, Percolating water, Riparian water, Economic efficiency, Legislation, Water utilization, Reasonable use, Usufructuary right, Water law, Water conveyance, Iowa.

In both the eastern and western states the increasing use of water is forcing reconsideration and modification of state water law. The basic thesis of this paper is that a system of water law should place emphasis upon the institutions of private property and the market process for the efficient allocation of water resources as contrasted with centralized planning based on administrative and judicial judgment. This paper presents a survey and evaluation of state water law as it affects individual decision-making process in the use and development of water resources. Although the doctrine of appropriation, as presently interpreted, is subject to a number of serious criticisms, it can be modified to provide the foundation for an improved system of water law. The riparian doctrine is ill suited to the development of transferable private property rights in water resources.
W68-01397

GEORGIA WATER LAW, USE AND CONTROL FACTORS,
Georgia Bar Assoc., Macon.
John L. Heim.
Ga B J, Vol 19, No 2, pp 119-131, Nov 1956. 12 p, 2 tab.

Descriptors: *Riparian rights, *Georgia, Prior appropriation, Judicial decisions, Legislation, *Droughts, *Surface waters, Natural flow doctrine, Reasonable use, Relative rights.

Due to the growing demands upon water resources in Georgia, the Georgia Legislature created the Georgia Water Law Revisions Committee to study water problems and make recommendations. Drought problems and their application to Georgia, and especially to the 1954 drought, are discussed. Irrigation being a consumptive use, causes the biggest problem during a drought. Two tables reflect Georgia water resources. A brief discussion of the prior appropriation and riparian rights doctrines is given. Georgia is a riparian state, and its statutes and cases to that effect are discussed. A riparian does not have property in riparian water, but merely a usufructuary right while it passes along. The criticisms of the riparian doctrine as expressed by those who favor the introduction of appropriation elements to eastern water law are set out. Drawbacks in the prior appropriation doctrine are pointed out, as are the problems of incorporating such doctrines into the riparian doctrine. One such problem is compensation for divested riparian rights.
W68-01402

6E. Water Law and Institutions

THE COLUMBIA RIVER TREATY,
Resources for the Future, Inc., Wash., D. C.
John V. Krutilla.
Water Research, Edited by Allen V. Kneese, and Stephen C. Smith, pp 69-97, John Hopkins Press: Baltimore, c 1966. 28 p, 1 map, 7 tab, 14 ref.

Descriptors: *United States, *Columbia River basin, International Joint Commission, *Evaluation, *Project planning, Project economics, Project benefits, *Benefit sharing, *Economic efficiency, Cost comparisons, Cost sharing, Cost benefit analysis, Hydroelectric power, Treaties.
Identifiers: *Canada, *Columbia River Treaty, British Columbia, International agreements, Kootenay, Bull River-Dorr project.

In the Columbia River Treaty, the U.S. and Canada agreet to a cooperative plan for the development of a river which they share. Using the principles formulated by the International Joint Commission (IJC), the Treaty can be evaluated from an economic viewpoint. According to General Principle No. 1 of the IJC, only projects for which there are no more economic alternatives should be included in the Treaty. In addition, projects should be constructed in the order of the most favorable cost-benefit ratio. The Treaty did not provide for a system which was as economical as that outlined by the IJC. The time lag between the negotiation and ratification of the Treaty also made the Treaty less economical. According to General Principle No. 2, neither country should be worse off under the Treaty than it would be by relying upon an independent domestic alternative to accomplish the same purposes. Since the U.S. had an alternative which would have been less costly than the Treaty while Canada did not, Canada benefited from the Treaty but the U.S. did not. However, the U.S. economic loss may have been compensated by gains such as political concessions in other areas. (Seneca-Rutgers)
W68-01064

WATER IN WEST PAKISTAN,
Syracuse University, Syracuse, Maxwell School of Citizenship and Public Affairs.
Guthrie S. Birkhead.
Water Resources Res, Vol 3, No 2, pp 307-318, 1967. 12 p, 26 ref.

Descriptors: *Water management (Applied), Cultivation, Drainage systems, Dams, Canals, *Irregation programs, *Water resources development, Saturated soils, Saline soils, Economics.
Identifiers: West Pakistan.

The article describes several of the salient problems of water and the administration of water programs in West Pakistan with emphasis on the West Pakistan Water and Power Development Authority and the Indus Basin Plan. In the early 1960's, it was estimated that about 100,000 acres of land per year in the Basin were being removed from cultivation due to poor cultural practices and drainage facilities. In 1960, the Indus Water Treaty was signed which provided for dams and canals to distribute water in the Indus Basin. Pakistan's agent to oversee the construction of these projects was the West Pakistan Water and Power Development Authority. (Blecker-Ariz)
W68-01096
Robert Emmet Clark.
Waters and Water Rights, Vol. 1, pp 1-582, Allen Smith Company, Indianapolis, 1967. 582 p, 4 plate, 1661 ref.

Descriptors: *Water rights, *Water utilization, Water law, *Taxes, Water resources, Riparian rights, Prior appropriation, Legislation, Federal Government, State governments, Classification, Groundwater, Surface waters, Reasonable use, Beneficial use, Water quality, Economics, Water policy, Public rights.

This is a comprehensive survey of water law throughout the United States. Emphasis is placed on the riparian and prior appropriation systems and their differences. Legislation at both the federal and state levels is discussed. One chapter is devoted to public rights in water uses and private rights in land which is adjacent to water. Ownership concepts are stressed. Another chapter is devoted to a classification and categorization of both water rights and water uses. Here again the riparian and appropriative systems are compared and contrasted. Reasonable and beneficial use is also emphasized. Water economics as it relates to law and water policy is the subject of another chapter. Emphasis is placed on the conflict or dichotomy between security and flexibility on the one hand, and protection of investment on the other. The final chapter is devoted to tax problems in the water area. Property taxes are the most burdensome, but there are also special taxes on water companies and income taxes, as well as various special assessments. (Breuel-Fla)
W68-01285

PLAN AND SCOPE OF THE WORK (ON WATER AND WATER RIGHTS),
Robert Emmet Clark.
In Waters and Water Rights, Vol. 1, pp 1-55, Allen Smith Company, Indianapolis, 1967. 55 p, 4 plate, 89 ref.

Descriptors: Water law, *Legislation, *Federal Government, *Water resources, Hydrologic cycle, Water utilization, Classification, Prior appropriation, Riparian rights, State governments, Administrative agencies, Federal-State water rights conflicts, Local governments, Law of the sea, Littoral, Coasts, International law, Administration.

Section One, Introduction, emphasizes the growth of the importance of water law in the United States. Section Two is devoted to the physical conditions and characteristics of water. This includes statistics on location and magnitude. The hydrologic cycle is introduced along with the primary uses of water in the United States. Section Three is entitled Water Law and Hydrology. The author notes the differences between law and science in the area of classification. There are four plates of the United States included. A subsection is devoted to other water categories, including waste water, foreign waters, salvage waters, artificial waters, storage waters, and primary waters. Section Four compares riparian and appropriation doctrines and explains their genesis. In addition, the systems of Alaska and Hawaii are noted. Section Five is devoted to the federal-state conflict. The author opens with the constitutional background, then federal legislation. He finally turns to federal agencies such as the Army Corps of Engineers. Section Six discusses international and shoreline controversies. Section Seven raises the problems of administration by state or local governments or organizations. Section Eight is entitled Water Law and Changing Conditions. (Breuel-Fla)
W68-01286

BACKGROUND AND MODERN DEVELOPMENTS IN STATE WATER - RIGHTS LAW,
Wells A. Hutchins.
In Waters and Water Rights, Vol. I, pp 60-175, Allen Smith Company, Indianapolis, 1967. 115 p, 99 ref.

Descriptors: Water law, *Riparian rights, *Prior appropriation, Water utilization, *State governments, Reasonable use, Beneficial use, Public rights, Watercourses (Legal), Groundwater, Climates, Classification, Administrative agencies, Legislation, Adjudication procedure, Water allocation (Policy), Irrigation districts, Planning.

Section 15 is devoted to the history of the riparian and prior appropriation systems in America. Section 16 explores the riparian rights in watercourses in more detail. Topics covered include the normal flow doctrine, reasonable use, special uses, and transfer or loss of rights. Section 17 encompasses groundwater. Section 18 is devoted to the history of the prior appropriation doctrine, including combination of the two systems in semi-arid states. Section 19 explores the beneficial use concept. Section 20 is concerned with public regulation of water rights, especially in the West. State administrative agencies are the topics of Section 21, while Sections 22, 23 and 24 are again primarily devoted to western systems for appropriation, adjudication, and administration. Section 25 introduces integrated administrative-judicial procedures, and Section 26 turns to water enterprise agencies. Section 27 discusses groundwater and statuatory law. Section 28 discusses the upsurge of national concern with water allocation problems. This includes a section of eastern concern with water problems. The final section is devoted to recent developments in water law, including those in the center of federal-state controversies. (Breuel-Fla)
W68-01287

PUBLIC RIGHTS IN WATER USES AND PRIVATE RIGHTS IN LAND ADJACENT TO WATER - DIV A: TRADITIONAL RIGHTS OF THE PUBLIC IN WATER USES,
Albert W. Stone.
Waters and Water Rights, pp 179-245, Allen Smith Company, Indianapolis, 1967. 66 p, 101 ref.

Descriptors: *Public rights, *Water utilization, *Navigable waters, Water law, Law of the sea, Beds, Coasts, Boundaries (Property), Inland waterways, Ownership of beds, Prescriptive rights, Eminent domain, Lakes, Access routes, History, Planning, State governments, Water resources development, California, Colorado.

Section 35 is devoted to the common law origins of public uses. It begins with the climatic and geographic factors. Early uses in England were fishery rights, navigation rights, and the use of river beds and banks. Section 36 covers navigable waters, beginning with the movement to free seas. This section also encompasses territorial waters, submerged lands, boundaries and the seacoast, and tidelands and beds. Section 37 deals with the use of inland waters both for navigation and recreation. The section commences with an historical view of navigation. Then attention turns to the federal concept of navigation and navigability. Bed ownership is discussed, as is the definition of waters which are subject to public use. The section ends with littoral rights. Section 38 is devoted to access problems, both constitutional and statuatory in nature. The discussion extends to access by prescription, dedication, and eminent domain. The final segment, Section 39, is devoted to western water law and public uses. Special emphasis is focused on the California and Colorado doctrines, as the basic systems of water law in the West. Public use of water in the West is the final subsection topic. (Breuel-Fla)
W68-01288

PUBLIC RIGHTS IN WATER USES AND PRIVATE RIGHTS IN LAND ADJACENT TO WATER - DIVISION B: PRIVATE RIGHTS IN LAND ADJACENT TO WATER,
Albert W. Stone.
In Waters and Water Rights, pp 245-279, Allen Smith Company, Indianapolis, 1967. 34 p, 79 ref.

Descriptors: *Land tenure, *Beds, *Shores, *Boundaries (Property), Banks, Tidal waters, Navigable waters, Non-navigable waters, Riparian land, Riparian rights, Public rights, Swamps, Intertidal areas, Docks, High water mark, Low water mark.

This segment is actually real property law. The author begins with a brief survey of the development of the English common law. He then discusses the origins of titles in the United States. The origin has a direct bearing on the rules of law on ownership beyond high water marks. Section 41 is devoted to the private ownership of land lying under water. Tidal waters are examined first, with emphasis on legislation. The next lands are those under nontidal navigable waters. Both English and American rules are given, as well as local and special variations. Land under nonnavigable waters is covered in conjunction with riparian ownership. Section 42 raises ownership problems of land between the high and low water marks. Generally, states own the foreshore to the sea. The author discusses both private and state ownership doctrines in conjunction with banks of nontidal navigable waters. Also included is ownership of banks of nonnavigable waters. Section 43 examines the rights to wharf out and to reclaim. Section 44 is devoted to boundary problems below high water. Both the public and private ownership problems are encompassed, the latter in a discussion of stream boundaries. (Breuel-Fla)
W68-01289

CLASSES OF WATER AND CHARACTER OF WATER RIGHTS AND USES - SECTION 51: WATER-LAW DOCTRINE,
R. Clark, and C. O. Martz.
In Waters and Water Rights, Vol 1, pp 287-300, Allen Smith Company, Indianapolis, 1967. 13 p, 86 ref.

Descriptors: *Riparian rights, *Prior appropriation, *Water law, Natural flow doctrine, History, Prescriptive rights, Reasonable use, Legislation, Priorities, Beneficial use, Water utilization, Land tenure.

This section is devoted to a discussion of the riparian and prior appropriation doctrines. Introductory comments point out that a number of states apply both doctrines, and some eastern states now employ a new riparian system. The history of the riparian doctrine focuses on a natural right to water contiguous to owned land. There was a riparian right to a natural flow. Reasonable use is the primary test under the riparian doctrine. Also covered are legislative changes, especially the Mill Acts and the doctrine of prior appropriation. Priorities distinguish appropriative from riparian doctrines. Further, the amount of water which is encompassed by an appropriative right is certain. Another differentiating factor is that an appropriative right may be lost by non use or by abandonment, and others. The authors conclude with a segment devoted to the essential differences between the two systems. (Breuel-Fla)
W68-01290

CLASSES OF WATER AND CHARACTER OF WATER RIGHTS AND USES - SECTION 52: THE PRINCIPAL CATEGORIES OF SURFACE AND GROUND WATERS,
R. Clark, and C. O. Martz.
In Waters and Water Rights, pp 300-344, Allen Smith Company, Indianapolis, 1967. 44 p, 201 ref.

Descriptors: *Classification, *Surface waters, *Groundwater, *Water law, Repulsion (Legal aspects), Civil law, Reasonable use, Natural streams, Floodwater, Lakes, Ponds, Swamps, Underground streams, Percolating water, Prior appropriation, Aquifers, Springs, Artificial watercourses.

The first surface water category is diffused surface water. The major problem in regard to diffused surface waters is diversion. These rules are applicable: common-enemy rule, civil-law rule, reasonable use or modified civil-law rule. Another surface water category is the watercourse or natural stream. Floodwaters are another source of surface waters. Lakes, ponds, sloughs, and swamps, though distinguishable, are in the surface waters category. Ground waters are divided into three categories: underground streams, percolating waters and aquifers. An underground stream which can only be discovered by excavation, is not subject to the rules applied to surface streams. Percolating waters are discussed in connection with the prior appropriation doctrine, the common law or English doctrine, the reasonable use rule, and the correlative rights doctrine. An aquifer is defined and explained via court decisions. The final major category is waters from special sources. The first source is springs. Seepage or leakage, waste or artificial water are the next special sources. Rules for seepage are not the same in all jurisdictions. Foreign water, salvaged or developed water, and storage or excess supply round out the special sources category. (Breuel-Fla)
W68-01291

CLASSES OF WATER AND CHARACTER OF WATER RIGHTS AND USES - SECTION 53: NATURE OF PROPERTY RIGHTS IN WATER,
R. Clark, and C. O. Martz.
In Waters and Water Rights, pp 344-366, Allen Smith Company, Indianapolis, 1967. 22 p, 120 ref.

Descriptors: *Real property, *Prior appropriation, *Riparian rights, *Water law, Navigable waters, Usufructuary rights, Water rights, Transfer, Limiting factors, Reasonable use, Beneficial use, Priorities, Water quality control, Natural flow doctrine,

Eminent domain, State governments, Federal Government, Judicial decisions.

Real property interests differ from personal property interests. Water rights are generally real property interests, along with land. The water right varies from riparian to appropriative jurisdictions. The ownership of navigable waters is with the public or the state generally. One major characteristic of the water right is that it is usufructuary in nature. There is no absolute ownership. In addition, there are proprietary rights, exemplified by the natural flow doctrine. Water rights are alienable and transferable, like other property interests. These conveyances are defined largely by judicial decisions. There are however, several physical and legal limitations on water rights. The first is quantitatively dependent upon the availability of the supply. Quality is also an inherent limitation. Riparian rights are limited by location of land, reasonable use rule, and quality impairment. Appropriative rights are limited by compliance with statuatory procedures and beneficial use of the water. They may also be limited by forfeiture and abandonment. The state's police power and the right of eminent domain may also limit one's water rights. The final limitation is the power of the federal government over water rights, via the commerce clause primarily. (Breuel-Fla)
W68-01292

CLASSES OF WATER AND CHARACTER OF WATER RIGHTS AND USES - SECTION 54: BENEFICIAL AND REASONABLE USES OF WATER,
R. Clark, and C. O. Martz.
In Waters and Water Rights, Vol 1, pp 367-376, Allen Smith Company, Indianapolis, 1967. 10 p, 70 ref.

Descriptors: *Reasonable use, *Beneficial use, *Preferences (Water rights), *Water utilization, Navigation, Domestic water, Municipal water, Stock water, Irrigation water, Mine water, Industrial water, Hydroelectric power, Recreation, Riparian rights, Prior appropriation.

The natural flow doctrine, in the extreme, did not provide for consumptive uses, but rather allowed natural uses. This illustrates the changes in the reasonable use rule, which is the basis of eastern water law. Beneficial use is adapted to the arid western conditions. Priorities are crucial to the appropriative system. There are three general classes of preferences: true preference, statuatory preferred uses, and administrative preferences. Navigation is a beneficial use. Domestic use is recognized under both riparian and appropriative systems. In the latter, it is given a preference. Treatment of municipal use varies under the two standards and systems. There is some question over prefereñces to institutions, such as hospitals, prisons, and military installations. Stock watering is both a reasonable and a beneficial use satisfying both systems. Under riparian law, the reasonable use test is applied to irrigation and the user must prove necessity. In the West, irrigation is a beneficial use. Water is beneficially used in mining and drilling operations. Manufacturing use is often considered with domestic use. Power production is also both a riparian and beneficial use. Water for recreation is reasonable and beneficial. (Breuel-Fla)
W68-01293

CLASSES OF WATER AND CHARACTER OF WATER RIGHTS AND USES - SECTION 55: QUANTITY AND QUALITY OF SUPPLY,
R. Clark, and C. O. Martz.
In Waters and Water Rights, Vol 1, pp 377-395, Allen Smith Company, Indianapolis, 1967. 18 p, 120 ref.

Descriptors: *Water quality, *Water quality control, *Water supply, *Legislation, Reasonable use, Riparian rights, Beneficial use, Prior appropriation, Consumptive use, Non-consumptive use, Judicial decisions, Duty of water, Diversion, Surplus water, Weather modification, Remedies, Water pollution, Federal Government.

Both the reasonable riparian use and the beneficial appropriative use have inherent limitations on quantity. Quality control is of modern origin; hence common law doctrines are not very helpful. An important categorization of water is into consumptive and non-consumptive uses. While the emphasis of water law has been on the former, the latter is very important, encompassing navigational and recreational uses. Other important distinctions are between beneficial use, diversion, duty, and waste. Significant problems are raised by scientific modifications of the weather and climate. These problems are legal as well as scientific. Water quality control is becoming one of this nations's most pressing problems. It encompasses naturally bad water and pollution by man's activities. Under the common law of riparian rights, pollution was actionable. Pollution is an unreasonable use. Inadequate common law remedies prompted state legislation, but it has been generally inadequate because it is remedial rather than preventive. Modern legislation is becoming more preventive, and it is widening the jurisdiction of agencies to meet pollution problems. The federal government is also becoming more active in the area of legislation against pollution. (Breuel-Fla)
W68-01294

WATER ECONOMICS: RELATIONS TO LAW AND POLICY,
S. V. Ciriacy-Wantrup.
In Waters and Water Rights, Vol. 1, pp 397-430, Allen Smith Company, Indianapolis, 1967. 33 p, 34 ref.

Descriptors: Water law, *Water policy, *Economics, Projects, Groundwaters, Marketing, Institutions, Welfare (Economics), Economic efficiency, Optimization, Flexibility, Water rights, Investment, Prescriptive rights.

The Introduction, Section 60, discusses the interrelationship of law and economics and public policy. The chapter aims to aid the student of the law in understanding economics and economic criteria. Section 61 develops the meaning of water policy, as restricted to interrelated actions. The economist separates water development and allocation. Water projects are discussed along with water policy and the significance of ground water. Water economics can be studied from a market viewpoint. Section 62 is devoted to the economic objectives and criteria of water policy. The subjects mentioned include welfare economies, optimum efficiency, benefit-cost analysis, maximization principles. Water institutions are also covered. Section 63 is devoted to implementing water policy. Emphasis is placed on the dichotomy between security and flexibility as related to the riparian and appropriative systems. Security of water rights is also analyzed in light of protection of one's investment. A brief conclusion follows the substantive text. (Breuel-Fla)
W68-01295

TAX PROBLEMS RELATING TO WATER RIGHTS AND WATERWORKS - DIV A AND DIV B: INTRODUCTION AND PROPERTY TAX,
Sho Sata.
In Waters and Water Rights, Vol. 1, pp 433-539, Allen Smith Company, Indianapolis, 1967. 106 p, 457 ref.

Descriptors: *Taxes, *Water rights, *Property values, Water law, Riparian rights, Prior appropriation, Public utilities, Water districts, Federal Reclamation Law, Assessments, Sites, Land tenure, Water utilization, Public lands, Federal government, State governments, Local governments.

Section 70 outlines the entire tax chapter. Section 71 explains the nature of the property tax as a general levy, not a special assessment. Property characterization is covered in Section 72. The major categories are riparian and appropriative water rights. Dams, canals, flumes, pipes, aqueducts, etc., are also characterized. The taxability of the right to receive water is the subject of Section 73. The right may be from a mutual company, the Bureau of Reclamation or a public utility. Controlled water taxability is the topic of Section 74. Section 75 studies special assessments. Section 76 covers the place of taxation of water rights, dams, canals, flumes, pipes, easements, etc. Valuation of property is in Section 77. Again the split between riparian and appropriative rights is relevant. Valuation of utilities is by several methods: unit method, enterprise method, apportionment of unit. Section 78 is devoted to private rights and facilities exempted from taxation. These include storage, diversion, distribution, electric power, and pollution abatement facilities. Section 79 covers exemption of public property, federal, state, and local. The latter may be exempted for ownership alone or use. (Breuel-Fla)
W68-01296

TAX PROBLEMS RELATING TO WATER RIGHTS AND WATERWORKS - DIV C: SPECIAL TAXES ON WATER AND ELECTRIC COMPANIES - DIV D: FEDERAL INCOME TAX PROBLEMS RELATING TO WATER RIGHTS AND H2O WKS,
Sho Sato.
In Waters and Water Rights, pp 539-582, Allen Smith Company, Indianapolis, 1967. 43 p, 205 ref.

Descriptors: *Taxes, *Water rights, *Income, *Water law, Utilities, Investment, Federal Government, Public utilities, Depreciation, Soil conservation, Water conservation, Withdrawal, Federal Reclamation Law, Expenditures.

Section 80 introduces the special taxes. Section 81 gives the parties subject to this special tax - water and electric companies. Some question exists as to co-operatives and mutual companies. The nature of the business activity which invokes the special tax is the Subject of Section 82, while Section 83 presents the measure of the tax. The rate is specified in Section 84. Division D is devoted to income tax problems. Section 87 considers the deductions to be allowed waterworks for expenditures of a business nature, for expenditures for soil and water conservation, depreciation, and depletion. The text is annotated with the appropriate Internal Revenue Code sections. Section 88 considers problems with investment credit. Exclusions and exemptions are subjects of Section 89. Mutual corporations are exempted. The final section is devoted to capital gains treatment of properties and rights. Non-taxable exchanges and gains from disposition of excess land are covered. (Breuel-Fla)
W68-01297

(THE COMMERCE CLAUSE AND THE NAVIGATION POWER),
Robert E. Clark, Edward W. Clyde, and Charles E. Corker.
In Waters and Water Rights, Vol 2, pp 1-42, Allen Smith Co., Indianapolis, Indiana, 1967. 42 p, 180 ref. See W68-01285 for general description of this two volume work.

Descriptors: *Appropriation, *Navigable waters, *Federal jurisdiction, Judicial decisions, Ownership of beds, Riparian land, Navigation, High water mark, Property values, Appropriable waters.
Identifiers: Navigation power.

Congressional navigation power included navigable streams and non-navigable waters affecting the navigability of navigable streams. Three tests of navigability exist: having been navigable; navigable in fact; navigable after reasonable improvements. Protection and improvement of navigation are the constitutional basis of congressional power but neither measure nor limit it. Congress's declarations that projects will benefit navigability, thereby creating a federal right of action, are legislative and not judicially reviewable except upon a showing of

impossibility. However such declarations must contain clear assertions of authority based on the navigation power. Navigable stream beds are subject to the power up to the ordinary high water mark even if this level is maintained artificially. Property rights below that line are defeasible without compensation under express exercise of the power. Loss of value to abutting uplands due to location on navigable streams is non-compensable but injury to property within or abutting non-navigable streams is compensable. If Congress expressly exercises its power over non-navigable streams the rules of navigable streams apply. State or congressional sanction or inaction regarding the right does not estop the government but congressional recognition of compensability thereof is effective.
W68-01298

(THE NEED FOR RECONSIDERATION OF THE NAVIGATION SERVITUDE),
Robert E. Clark, Edward W. Clyde, and Charles E. Corker.
In Waters and Water Rights, Vol 2, pp 42-51, Allen Smith Co, Indianapolis, Indiana, 1967. 9 p, 18 ref. See W68-01285 for general description of this two volume work.

Descriptors: *Appropriation, *Navigable waters, Federal jurisdiction, *Appropriable waters, Non-navigable waters, Easements, Right of way, *Consumptive use, Withdrawal.

No compensation is required for federal impairment or destruction of state created consumptive water rights on navigable streams or for state created priorities ignored in the distribution of project water among intrastate users. While federal participation in creating the consumptive right might be a basis for estoppel this question is unsettled. Consumptive rights on non-navigable tributaries are treated as those on the navigable mainstream provided the federal government expressly exercises its power over the tributary in order to protect the navigability of the mainstream. If exercise of the power is limited to the mainstream, consumptive rights on non-navigable tributaries are compensable. Authority supports the proposition that desert uplands may be valued as dry rather than irrigated land when appropriated in connection with navigation-power projects. The navigation servitude has permitted non-compensable taking of private property even where not incident to exercise of regulatory power. It evolved from a rule intended to permit unhindered passage on navigable waterways to its present scope through judicial confusion rather than design. Congress should correct this even if only by project-to-project determination of compensability of such rights.
W68-01299

(THE FEDERAL PROPRIETARY POWER IN WATER RIGHTS).
Robert E. Clark, Edward W. Clyde, and Charles E. Corker.
In Waters and Water Rights, Vol 2, pp 51-82, Allen Smith Co, Indianapolis, Indiana, 1967. 31 p, 111 ref. See W68-01285 for general description of this two volume work.

Descriptors: *Appropriation, Navigable waters, Federal jurisdiction, State jurisdiction, *Appropriable waters, Withdrawal, Non-navigable waters, Judicial decisions, Desert Land Act, *Reservation Doctrine, *Unappropriated water, Prior appropriation, Priorities.

Power to reserve, consume and dispose of water at well, though incident to neither the riparian nor appropriation doctrines, appears to be within the scope of the federal proprietary right vis-a-vis navigable and nonnavigable unappropriated water. Due to its original ownership of public lands, the U. S. has proprietary rights to all nonnavigable waters in public-land states except those which have been validly appropriated under state laws. To protect against such appropriation public lands may be withdrawn from public entry. The effect is that appropriations made before withdrawal are uneffected and subsequent appropriations do not cut off federal rights to water reserved by withdrawal so that federal taking of such water, though later in time of actual use would not be compensable to private appropriators. Federal reservation of unappropriated navigable waters is accomplished under its powers to regulate navigable waters and to regulate government lands. Compacts of admission, constitutional requirements of equal footing and federal legislation have been ineffective in changing the existence of federal sui-generis rights in waters of public lands.
W68-01300

(THE NEED FOR A NATIONAL WATER POLICY),
Robert E. Clark, Edward W. Clyde, and Charles E. Corker.
In Waters and Water Rights, Vol 2, pp 83-109, Allen Smith Co, Indianapolis, Indiana, 1967. 26 pp, 109 ref. See W68-01285 for general description of this two volume work.

Descriptors: *Appropriation, *Federal-state water rights conflicts, *Federal jurisdiction, Political aspects, Judicial decisions, Water allocation (Policy), State jurisdiction.
Identifiers: McCarran Amendment, Sovereign immunity.

The spending power offers a basis for vast federal reservation of water resources. Injunctive relief against federal officials involved in federal water-resources projects is unavailable except where such offices act beyond their statutory authority or where, though acting within their authority, such authority or manner in which it is exercised is constitutionally void. The McCarran Amendment purports to waive federal sovereign immunity in water-rights litigation. However, it has been construed to apply only to suits in which plaintiffs seek to settle their rights against all others asserting rights in the same water, thereby greatly reducing the effect of the statute. Federal courts have no jurisdiction under the amendment. Full of ambiguities and conflicts, the act needs revision and the entire issue of sovereign immunity vis-a-vis water rights needs reappraisal responsive to recent criticism of that doctrine. The scope of federal water legislation leaves no doubt as to Congress's authority. A national water policy is needed for a time when extensive federal powers will be required to reallocate water among the states. The states should adopt a master plan co-ordinating water use among themselves.
W68-01301

WATER RESOURCES RESEARCH PROGRAM.

42 USCA Sec 1961a-4, 1961c-7 (1967 Supp), pp 8-9. 2 p (80 Stat 129).

Descriptors: *Legislation, *Water Resources Research Act, *Grants, *Administrative agencies, Administration, Federal Government, Water resources development.
Identifiers: Secretary of the Interior.

Sec 1961a-4 of the Water Resources Research Act was amended to delete the requirement of annual reports from the Secretary of the Interior to Congress concerning the receipts, expenditures and work of the institutes. Sec 1961b was amended to provide increased appropriations and to withdraw the veto power over programs which were previously given to the House and Senate Interior and Insular Affairs Committees. A report similar to the original report the Secretary of the Interior was required to make to Congress, is required by the amendment to be made to the President and Congress (Sec 1961c-7). (R. F. Williams-Fla)
W68-01306

COLBERG, INC V STATE: RIPARIAN LANDOWNER'S RIGHT TO EMINENT DOMAIN RELIEF FOR STATE IMPAIRMENT OF ACCESS TO A NAVIGABLE WATERWAY,
Edward J. Benett.
Dick L Rev, Vol 72, No 2, pp 375-399, Winter 1968. 25 p, 111 ref.

Descriptors: *Judicial decisions, *California, *Damages, *Access routes, Riparian rights, Navigable waters, State jurisdiction, Highways, Bridges, Public rights, Water law, Compensation, Condemnation, State governments, Riparian land, Ships, Eminent domain, Remedies.

In Colberg, Inc v. State, 67 Cal 2d 410, 432 P 2d 3, 62 Cal Rptr 401 (1967), the California Supreme Court denied compensation to a riparian landowner when marine access from his shipyard to deep water was impaired by a state highway bridge. The court advanced the theory that state powers with respect to navigable waters were wider in scope than those of the federal government. The holding is questioned on the theory that a taking of private property for public use must be compensated. Most states recognize rights of access as private property rights. However, some courts adopt a narrow view of the right of access and hold that once the owner moves into the river, his right is public, subject to state interference without compensation. A broader interpretation would prevent downstream impairments. The right to use property is also discussed. Several constitutional questions are raised, including the Fifth Amendment taking of private property. A state may not be liable for interfering with a private property right if it has special powers over its navigable waters. Injured riparian landowners may recover the value of property under the inverse condemnation theory. (Breuel-Fla)
W68-01314

PRIVATE WATER RIGHTS IN FRANCE AND IN THE EASTERN UNITED STATES,
Ludwik A. Teclaff.
Amer Jour of Comparative Law, Vol 11, No 4, pp 560-573, Autumn 1962. 14 p, 40 ref.

Descriptors: Natural flow doctrine, Civil law, *Riparian rights, *Foreign countries, United States, Surface waters, Underground streams, Public rights, History, Reasonable use, Industrial water, *Administrative decisions, Riparian land, Streams.
Identifiers: Comparative law, France, England, Roman law.

Both France and the Eastern United States adhere to the riparian rights doctrine because of direct influence of the Code Napoleon as well as similarities in climate and water supply. In both countries rights of water use were welded as closely to private property law as the nature of water permitted. Landowners were given full ownership of surface and underground water and restricted but exclusive rights to use of waters of small streams. Both countries distinguish public from non-public streams on the basis of navigability and accord them different treatment, for example limiting riparian ownership to non-public stream beds. French riparian rights resemble American reasonable use rather than natural flow doctrine, since no hierarchy of uses is set up and courts are given wide discretion. French administrative law with respect to industrial uses of water is more developed than American. The author anticipates an increased role for public administration in both nations as the interrelationship of all water resources becomes better understood. (MacMillan-Fla)
W68-01320

WATER RESOURCES LAW,
Roscoe C. Martin.
In Water for New York, pp 91-115, Syracuse Press, 1960. 24 p, 29 ref.

Descriptors: *New York, *Judicial decisions, *Legislation, Water law, Water resources, Watercourses (Legal), Natural streams, Surface waters, Percolating water, Domestic water, Reasonable use, Riparian rights, Prior appropriation, Administrative decisions, Interstate compacts, Administrative agencies.

New York's Constitution provides for the protection of water rights via the property right clause. Water rights are free from arbitrary state interference. In addition specific provisions as to drainage, canals, reservoirs, etc, are in the Constitution. New York's common law, enunciated by the courts, classified waters into natural watercourses and lakes, surface waters, and percolating waters, each with distinct types of rights. A New York riparian landowner has a right to continued flow, use without injuring others and use without being injured. The author next discusses uses and the rule of reasonableness. Attention is then focused on statutes, administrative regulations, interstate compacts and agreements. An appraisal of New York water law is next. The common law discussion emphasizes the riparian doctrine and its flexibility. The review of statuatory law reveals a haphazard approach to legislation. New York lacks a separate compilation of water law. This would be inherent in a total need of water resources. The final segment deals with the legal reform movement. This involves a comparison of riparian and appropriation systems, especially in their capacity to meet the problems likely to be recurrent in New York. (Breuel-Fla)
W68-01324

RIPARIAN RIGHTS - INLAND WATERS - RIGHT OF AN OWNER OF LAND ABUTTING ON INTER-TRACT LAKE TO THE USE OF THE ENTIRE SURFACE,
Robert D. Hartl.
North Dakota Law Rev, Vol 37, No 1, pp 120-122, Jan 1961. 3 p, 16 ref.

Descriptors: *Riparian rights, *Minnesota, Ownership of beds, *Lakes, Navigable waters, Judicial decisions, Water rights, Water law, Watercourses (Legal).

This article consists of a commentary on the decision in Jefferson v Seifert, 100 N W 2d 269 (Minn 1960), which held that the plaintiff was entitled to an injunction against the defendant, who had erected a fence across a lake. The trial court had held that the defendant was entitled to erect the fence on the basis of his ownership of the lake bed and overlying waters. Various rules which might have applied to the facts of the case are examined. Some jurisdictions, following the English rule that non-navigable lake bottoms are susceptible of private ownership, have restricted use of the lake waters to those overlying the privately owned bed. The article concludes by praising the court in the instant case for holding that a riparian owner has the right to use the entire surface of the lake. (Patterson-Fla)
W68-01328

NAVIGABLE WATERS - RIGHTS OF RIPARIAN OWNER HELD NOT TO INCLUDE THE RIGHT TO CONSTRUCT A PERMANENT DEEP WATER DOCK INTO LAKE HURON,
For primary bibliographic entry see Field 04C.
For abstract, see .
W68-01329

LIABILITY FOR DIVERSION OF SURFACE WATERS.
For primary bibliographic entry see Field 04C.
For abstract, see .
W68-01330

THE STATE V THE RIPARIAN: A PROBLEM OF WATER USE AND CONTROL.
Wash U L Q, Vol 1961, No 3, pp 257-271, June 1961. 15 p, 89 ref.

Descriptors: Water utilization, *Navigable waters, Ownership of beds, Riparian rights, Management, Regulation, Taxes, *Public rights, Water law, Watercourses (Legal), *Water control.
Identifiers: *Police power, *Water management (Legal aspects).

One of the most difficult problems in the water management area lies in the theory under which the states assert control over waters which have been privately administered. One of the first problems to be met is found in the navigability doctrine, which holds that the beds of all lakes and streams navigable at the time entered the Union are held by the state in trust for the public. The federal test of navigability is based on suitability for commerce, although state navigability tests are generally much broader and may serve as a starting point in gaining more public use and greater state control. An examination of public ownership theories reveals that if they are combined with the police power of a state, effective state regulation and more public access can be achieved. Limitations on the police power are not broad, and as a general proposition, even though private property rights are destroyed, there is no compensable taking of property if the exercise of the police power was valid. Granting special tax benefits to encourage riparians to permit public entrance may be helpful on a minor scale. (Patterson-Fla)
W68-01333

REAL PROPERTY - WATERS AND WATERCOURCES - LIABILITY FOR DAMAGE CAUSED BY OBSTRUCTION OF PERCOLATING WATERS.
For primary bibliographic entry see Field 04C.
For abstract, see .
W68-01334

URBAN DRAINAGE: ASPECTS OF PUBLIC AND PRIVATE LIABILITY,
For primary bibliographic entry see Field 04C.
For abstract, see .
W68-01335

IMPLIED COVENANT TO PROTECT LEASED PREMISES FROM DRAINAGE WHERE LESSEE IS RESPONSIBLE FOR DRAINAGE,
For primary bibliographic entry see Field 04C.
For abstract, see .
W68-01336

PUBLIC RIGHTS IN INDIANA WATERS,
Graham G. Waite.
Ind L J, Vol 37, No 4, pp 467-488, Summer 1962. 22 p, 98 ref.

Descriptors: Indiana, *Ownership of beds, *Recreation, Lakes, Navigation, *Riparian rights, Statutes, Easements, *Eminent domain, Administrative decisions, Zoning, Watercourses (Legal), Right-of-way, Judicial decisions, Riparian waters.
Identifiers: Public trust doctrine.

Public rights to use water in Indiana are of statutory origin, except for the rights of navigation and fishing. The statutory rights apply only to lakes and do not apply to streams at all. Thus, even though streams that are useful have been declared to be public water, only the narrow rights of public use created by the Indiana Supreme Court exist on streams. The meaning of the statutes is clouded by obscure language. The statutes are of doubtful constitutionality since no compensation to riparians situated on formerly private lakes is provided, although the state has the right to make such lakes available for public use. In fact, the rights made available under the statutes have not been implemented administratively. The fact that Indiana water rights are statutory leaves the sportsman in a bad position because amendments may alter the law easily, where in the case of court-made law, stare decisis, tends to resist change. The article also summarizes the early case law of public rights in Indiana water. (Crabtree-Fla)
W68-01337

LIABILITY RESULTING FROM ARTIFICIAL BODIES OF WATER.

Iowa L Rev, Vol 48, No 4, pp 939-954, Summer 1963. 16 p, 80 ref.

Descriptors: Iowa, *Artificial watercourses, *Water pollution, Legislation, Judicial decisions, *Accidents, Safety, Riparian rights, Recreation, Social aspects, Drowning, *Hazards, Swimming, Access routes.
Identifiers: *Attractive nuisance, Restatement of Torts, Playground rule, *Children.

The article basically treats injuries to children. It explores the attractive nuisance doctrine generally, and then applies it to artificial bodies of water. The Restatement of Torts position is analyzed as to attractive nuisance in general, and artificial bodies of water specifically. Other theories on which landowners' liability may be predicated are explored. These are: (1) nuisance, (2) strict liability, (3) dangerous instrumentalities, and (4) the 'playground' rule which elevates trespassing children to licensees. The article points out that for the most part liability here must be based on the attractive nuisance concept. The article concludes that the trend in attractive nuisance cases seems to be toward the adoption of a negligence-oriented doctrine and the disregard of the status of the child. After an intensive examination of the relevant Iowa law, the article concludes that, at least in Iowa, there will be no liability for injuries arising from contact with artificial bodies of water even if a foreseeability test were applied. The current state of the law is not a realistic deterrent to the construction of artificial bodies of water. (Crabtree-Fla)
W68-01338

HIGHWAYS - FLOOD DAMAGE - PROPOSED MODIFICATION OF COMMON ENEMY RULE,
For primary bibliographic entry see Field 04C.
For abstract, see .
W68-01339

COMMON, PUBLIC, AND PRIVATE THINGS IN LOUISIANA: CIVILIAN TRADITION AND MODERN PRACTICE (WATERBODIES),
A. N. Yiannopoulos.
La L Rev, Vol 21, No 4, pp 697-748, June 1961. 52 p, 246 ref.

Descriptors: *Civil law, *Water law, *Louisiana, *Watercourses (Legal), Riparian rights, Public rights, Usufructuary right, Accretion (Legal aspects), Lakes, Rivers, Ownership of beds, Navigable waters, Bayous.
Identifiers: *Louisiana Civil Code.

The provision of the Louisiana Civil Code distinguishing between things public and private needs to be read in conjunction with another section, which divides things into common, public, and private. Thus the first distinction indicates which of the things in the latter categories are susceptible of ownership and which are not. Common things not susceptible of ownership include running water, the sea, ie, the Gulf of Mexico and Lake Pontchartrain, and the seashore. Problems in classifying these things in this manner, eg, whether marshlands and bayous are included in the term sea, are discussed. Among public things not susceptible of ownership are navigable rivers and their beds, and other navigable waters such as lakes, bays and sounds. Problems involved in assertion of state ownership of the beds of these waterbodies, and land formed by alluvion and dereliction, are discussed. A highway of commerce test is used to determine navigability. A thing in the private domain which has been given to public use is the bank of a navigable river. While ownership of such banks is vested in the riparian landowner, use of the banks is made public by the Code. (Patterson-Fla)
W68-01340

WATER SUPPLY ACT OF 1958.

43 U S C sec 390b (1964). 2 p (72 Stat 319).

Descriptors: *Legislation, Federal government, State government, *Water resources development, Local governments, Water supply, *Water storage, *Reservoir storage, Cities, Industries, Municipal water.
Identifiers: *Water Supply Act of 1958.

Congressional policy is declared to be that the development of water supplies for domestic, municipal, and industrial and other purposes should be a primary responsibility of the states and localities, and that the federal government, in developing projects, should cooperate fully with them. Water storage for present or future anticipated demands for municipal or industrial water is authorized in Corps of Engineers and Bureau of Reclamation Reservoirs. The cost of any construction or modification for such purposes must be paid by the State or local interest involved. Provisions are made for such payment. Costs for anticipated future demands may not exceed 30% of the entire estimated cost of the project. Major changes in federal projects may be made only with congressional approval. (Williams-Fla)
W68-01342

SOME CURRENT AND PROPOSED WATER-RIGHTS LEGISLATION IN THE EASTERN STATES,
State U of Iowa, Iowa City.
Harold H. Ellis.
Iowa L Rev, Vol 41, No 2, pp 237-263, Winter 1956. 27 p, 64 ref.

Descriptors: *Legislation, *Prior appropriation, Riparian rights, Administrative agencies, Administration, Water law, Legal aspects, *Permits, Wisconsin, Arkansas, North Carolina, South Carolina, Michigan, Minnesota, Streamflow, Diversions, Planning, Water resources, Development.
Identifiers: Constitutional aspects, Vested rights.

Existing water-rights legislation is reviewed with emphasis on the Wisconsin, Minnesota and North Carolina permit systems. Proposals in 5 states which would place regulation in the hands of administrative agencies and introduce some elements of the prior appropriation system are examined. A South Carolina bill purported to establish the doctrine of prior appropriation with respect to surface watercourses, excepting domestic uses and vested rights. A North Carolina bill was essentially similar. An Arkansas bill sought to establish a prior appropriation system excepting domestic uses, and providing that priority in time would give superior rights. A commission was to refuse appropriations that were in conflict with the public interest. The most limited bill was Michigan's. It made riparian rights and other uses vested rights, with excess water subject to appropriation. Wisconsin's bill applied to both surface watercourses and groundwater, and granted broad powers to the agency which would administer it. A comparison of the doctrine of prior appropriation and the doctrine of riparian rights is given. Minimum necessary legislative changes and constitutional problems are outlined, and several other considerations are discussed. (Williams-Fla)
W68-01347

WATER LAW AND POLICY IN THE SOUTHEAST.
Institute of Law and Government, College of Law, Georgia Univ., Athens.

In Water Law and Policy in the Southeast, pp 1-338, 1961. 338 p, 3 append, 342 ref.

Descriptors: Water law, *Southeast US, *Water policy, *Legislation, Water utilization, Surface waters, Groundwater, Riparian rights, Water pollution control, Administration, Local governments, State governments, Low flow, Impoundments, Planning, Economics, North Carolina, Florida, Administrative agencies, Mississippi.

The papers are compiled to form a composite of the major problems and solutions relating to water control and use in the Southeast. The first paper covers the common law as to the use of surface and ground waters. Another paper surveys the statutes in each of the Southeastern states which govern the administration of water use. The Iowa system and a model act are included. Mississippi law and administration is the subject of a separate study. Three papers are devoted to water pollution control programs stressing the legal bases for control and North Carolina programs. Water use law in a specific region of North Carolina is also examined with emphasis on certain arrangements made by the users to guarantee their supply. The economics of water use are also covered. A section is devoted to water regulation in local areas by federal, state, and local governments and districts. Florida is the subject of one paper emphasizing the administration of water laws by a state board. In addition, a paper presents the laws of minimum stream flows and impoundments. The final article is devoted to planning and the U S Study Commission. (Breuel-Fla)
W68-01348

COMMON LAW RULES REGARDING THE USE OF SURFACE AND GROUND WATER IN THE SOUTHEASTERN STATES,
Institute of Law and Government, School of Law, Georgia Univ., Athens.
Royal G. Shannonhouse.
In Water Law and Policy in the Southeast, pp 6-23, 1961. 17 p, 94 ref.

Descriptors: Water law, *Surface waters, *Ground water, *Southeast US, Riparian rights, Reasonable use, Natural flow doctrine, Watercourses (Legal), Underground streams, Beds, Obstruction to flow, Impoundments, Diversion, Surface runoff, Repulsion (Legal aspects), Dams, Civil law, Lakes, Ponds, Riparian land.

The paper is devoted to the common law of natural, nonnavigable watercourses, both above and below the earth's surface. Within the description of watercourses are subterranean streams and streams as boundaries. The riparian interest depends on ownership of land. The riparian doctrine is a natural flow subject to reasonable use doctrine. Generally, a riparian owner is not liable for natural obstructions. Artificial obstructions are governed by a rule of equal rights of other riparian owners. Dams, impoundments, diversions, and obstructions are discussed. Diffused surface water is defined and distinguished from flood waters. There are two general rules as to diffused surface waters, the common enemy and the civil law. A discussion of streets and sewers and the accompanying liability for negligence or damage is included. Definitions of lakes and ponds are given along with a discussion of littoral ownership. The usual rule is one of ratable ownership with other littoral owners. Beds of nonnavigable lakes and ponds are subject to private ownership. The rights and duties of owners of lake beds and littoral properties are discussed.
W68-01349

STATUTES FOR ADMINISTERING WATER USE IN THE SOUTHEAST,
Institute of Law and Government, School of Law, Georgia Univ., Athens.
Robert H. Marquis.
In Water Law and Policy in the Southeast, pp 25-45, 1961. 20 p, 46 ref.

Descriptors: *Legislation, *Administration, *Riparian rights, *Water utilization, Southeast U S, Prior appropriation, Administrative agencies, Diversion, Water resources development, Natural flow doctrine, Reasonable use, Domestic water, Docks, Water storage, Iowa, Michigan, Water permits, Irrigation permits, Water law.

Water use statutes have made relatively little change in the common law in the Southeast. In Alabama, several statutes alter the common law, including one which broadens the rule against diversion, another governing the right to wharf and change tolls. Florida has altered the common law more than any other Southeastern state, still keeping within the riparian system. The State Board of Conservation within the Department of Water Resources is crucial to Florida water law. Georgia statutes have little effect on the common law but they are studying water problems. Kentucky follows the natural flow rather than the reasonable use doctrine. Mississippi follows the prior appropriation rather than the riparian rights system. North Carolina has a few statuatory modifications of the common law. South Carolina is entirely common law governed. Tennessee, while retaining the common law, actively continues study of problems. Virginia has a detailed statuatory scheme. Also discussed is the Iowa System of Water Administration, which centers around a representative council. The University of Michigan Model Act is analyzed with emphasis on permits and procedures. The final segment is devoted to an analysis of the permit system.
W68-01350

MISSISSIPPI WATER-USE LAWS AND ADMINISTRATION,
Institute of Law and Government, School of Law, Georgia Univ., Athens.
Samuel A. Thompson.
In Water Law and Policy in the Southeast, pp 47-64, 1961. 17 p, 22 ref.

Descriptors: *Mississippi, *Legislation, *Prior appropriation, *Administration, Administrative agencies, Administrative decisions, Water law, Surface waters, Beneficial use, Priorities, Regulated flow, Natural flow, Water permits, Average flow.

Interest in Mississippi water use and supply problems was prompted by drought from 1952 to 1956. Studies showed the present riparian system inadequate. The Mississippi Inter-Organizational Committee on Water Resources was formed to study the problems and issue a report. Legislation resulted in the creation of the Mississippi Water Resource Policy Commission which moved for more legislation in water law areas. In 1956, the Mississippi Water Rights Law was passed, which pertains to surface waters. A Board administers the Act, with legal assistance of the Attorney General. The Act provides for prior appropriation and beneficial use. Priorities for use are not established except that domestic users may acquire an appropriative right. Priorities in time are covered by amendments after the Act. Minimum flow regulation questions also come under the statute. Public notice must precede a permit grant. Other topics discussed are the right to fill, irrigate, divert, and control of the average minimum flow. The legislature has protected the average minimum flow of streams. Recent amendment proposals and enactments are also discussed.
W68-01351

LEGAL BASIS FOR WATER POLLUTION CONTROL,
Institute of Law and Government, School of Law, Georgia Univ., Athens.
Roddey M. Ligon.
In Water Law and Policy in the Southeast, pp 88-113, 1961. 25 p.

Descriptors: *Water law, *Water pollution control, *Legislation, *Administration, State governments, State jurisdiction, Judicial decisions, Public health, Administrative agencies, Water quality control, Remedies, Inspection, Water policy, Water pollution.

Stream pollution control is not a recent development, but since the end of World War II, increased pollution has prompted renewed legislation interest and action. Water pollution control legislation may

be enacted by state legislatures via the police power. Judicial decisions supporting this contention are given. A model control act is presented and discussed by sections. Sections recommended include a statement of policy and definitions. An autonomous agency should be organized to regulate the pollution program. The specific agencies of several states are discussed. The most important section should define the powers and duties of the agency. Another section of importance is the prohibition of pollution actions and granting of permit powers to the agency. Procedural requirements, especially pertaining to hearings before the agency should be specifically provided for in the act. The agency must comply with constitutional due process. Enforcement of agency decisions and orders may be civil or criminal law oriented. In the conclusion, the author recommends frequent reexamination of water pollution laws.
W68-01352

WATER POLLUTION CONTROL IN NORTH CAROLINA,
Institute of Law and Government, College of Law, Georgia Univ., Athens.
Wilbur E. Long.
In Water Law and Policy in the Southeast, pp 114-123, 1961. 10 p.

Descriptors: *North Carolina, *Water pollution control, *Legislation, *Administration, Pollution abatement, Water quality control, Surface waters, Public health, Classification, Permits, Asministrative agencies, Planning.

North Carolina has an abundant yet fixed volume and amount of water assets. The various uses of water increase. Conservation depends to a large degree on reuse, which raises the problem of pollution control. Legislation protecting the public water supply in North Carolina began in 1893. Despite frequent amendments and new legislation, reexamination is necessary. The present law was passed in 1951. The state assumes responsibility for the water quality. The State Stream Sanitation Committee established classifications for fresh surface waters. Future classifications are up to this same body, and must be done on an entire river basin at a time. This involves surveying, sampling, public hearings, planning, and the granting of permits. The key element is the Comprehensive Pollution Abatement Plan. At present (1961), 81 per cent of North Carolina's fresh surface water area has been classified. The author includes projections for the future about North Carolina's pollution control.
W68-01353

WATER USE LAW IN ACTION,
Institute of Law and Government, College of Law, U of Georgia, Athens.
Milton S. Heath, Jr.
In Water Law and Policy in the Southeast, pp 132-174, 1961. 42 p, 3 append.

Descriptors: *Water law, *Water utilization, *North Carolina, *Water users, Municipal water, Water supply, Irrigation, Industrial water, Recreation demand, Water rights, Land tenure, Riparian land, Judicial decisions, Remedies, Federal government, Administrative agencies, Legislation, Institutions, Riparian rights, Water policy.

Emphasis is on water user arrangements particularly those in the Research Triangle Region in North Carolina, encompassing Durham, Orange, and Wake Counties. A description of the region is given including physical and economic characteristics. The water users are municipal, agricultural (primarily irrigation), industrial, and recreational. Water rights of two of the above users is discussed, municipal and irrigational. In addition, the Corps of Engineers and the United States Soil Conservation Service are noted under water rights. Also considered are the effects of existing laws and institutions on water sources and economic growth, especially the riparian system and the public interest in continuation of water usage. Judicial decisions are provided. The law as to diversion is presented and analyzed with emphasis on legislation. This raises a constitutional problem. As to remedies, the legislation in North Carolina may effect injunctions. The final consideration is the existing policy of the law of North Carolina, with examples. Appendixes pertaining to information gathering, sample questionnaires, maps and tables of self supplied industries are included.
W68-01354

REGULATION OF WATER USE IN LOCAL AREAS BY STATE OR LOCAL GOVERNMENTS AND DISTRICTS,
Institute of Law and Government, College of Law, Georgia Univ, Athens.
Harold H. Ellis.
In Water Law and Policy in the Southeast, pp 238-284, 1961. 46 p, 111 ref.

Descriptors: *Water law, *Legislation, *Local governments, *State governments, Water districts, Administrative agencies, Administration, Boundaries (Property), Surface waters, Groundwater, Water utilization, Watercourses (Legal), Regulation, Political aspects, Water permits, Water policy.

Eastern water problems are due to decreasing abundance. Regulation in local areas may be accomplished by state agencies. Some state statutes, such as New Jersey's, exempt certain uses and create an agency to delineate such uses. Similar legislation has been enacted in Indiana and Hawaii, the latter to ground water only. Florida legislation extends to both surface and groundwater. Alternatives to the above legislation are found in a Wisconsin proposal. Another alternative is found in North Carolina's pollution control program. Regulation may also be by local districts or governments, such as conservation, watershed, and irrigation districts. Examples are drawn from Illinois, Texas, Florida, North Carolina. Another category is the regulation of use of water resources developed by local governments or districts. While such resource uses may continue under existing water rights systems, new rules and regulations may be added. Emphasis is placed on state enabling legislation such as that found in Ohio. Indiana, Florida, and Illinois legislation is also considered. The final segment is devoted to possible constitutional questions. Emphasis is placed on draftsmanship to avoid such problems as due process and state powers.
W68-01355

EASTERN LAWS CONCERNING MINIMUM STREAM FLOWS AND IMPOUNDMENTS,
Institute of Law and Government, College of Law, U of Georgia, Athens.
Frank E. Maloney.
In Water Law and Policy in the Southeast, pp 294-322, 1961. 28 p, 69 ref.

Descriptors: *Low flow, *Impoundments, *Water law, *Riparian rights, Low flow augmentation, History, Administrative agencies, Navigable waters, Interstate compacts, Water pollution control, Legislation, Permits, Withdrawal, Federal government, Water storage, Flood control, Irrigation, Small watersheds.

Historically, most eastern states followed the natural flow doctrine which eliminated the minimum flow problem because the lower owner could demand the entire flow. The reasonable use doctrine changed this situation. Some basic problems which may exist when drawing a stream toward its minimum flow include navigability requirements, interstate compacts, pollution control, and protection of fish and wildlife. Physical problems include numerical determinations of minimum flow, measurement methods, and groundwater percolation. Permit systems suffer from a lack of flexibility. One solution is the permissive permit found in Florida. Permit issuance hearings are both mandatory and permissive. Enforcement of permit systems is also discussed. Irrigation impoundments are related minimum stream flows. Some impoundme legislation allows for withdrawal permits. Storage the best way to utilize existing water supplies wh maintaining minimum flows. The federal gover ment is active in several impoundment areas cluding power development, flood control, irrig tion, and water control projects. A crucial co sideration in these areas is whether federal or sta law applies, and the overall status of the state. the conclusion, the interrelationship of minimu stream flows and impoundments is stressed.
W68-01357

WATER RESOURCES PLANNING IN TH SOUTHEASTERN UNITED STATES,
Institute of Law and Government, School of La U of Georgia, Athens.
J. W. Woodruff, Jr.
In Water Law and Policy in the Southeast, pp 32 338, 1961. 11 p.

Descriptors: *Planning, *Administratio *Southeast U S, Water resources, Legislatio Water law, Water policy, Land resources, Projec Economic feasibility, Water pollution control, Su face waters.

Water resources planning should meet futu needs. Water is the key to population growth. Th United States Study Commission, Southeast Riv Basins has a new approach to river basin plannin The Commission aims to maximize benefits in th study area, which is 88,000 square miles Alabama, Florida, Georgia, and South Carolin and 200 square miles in North Carolina. The artic lists eleven functions of the Commission, plus twelfth which is a catch-all phrase. Equal emphas is on land and water. The Commission is a plannir group, given a great deal of flexibility and reac Work is done with federal, state, and local age cies, particularly in the research area. There is four step approach to planning; first, an invento of resources; second, a projection of future need third, single purpose plans; fourth, an overall cor prehensive plan. The policies and guidelines of th Commission are outlined. Water pollution is necessary area of concern. The Commission see to maximize the use of streams and basins with the bounds of state water laws.
W68-01358

WATER PURITY: A STUDY IN LEGAL CO TROL OF NATURAL RESOURCES,
For primary bibliographic entry see Field 05G.
For abstract, see .
W68-01360

WATER PURITY: A STUDY IN LEGAL CO TROL OF NATURAL RESOURCES,
Earl F. Murphy.
Wisconsin Univ. Press, Madison, pp 3-212, 196 209 p.

Descriptors: *Wisconsin, *Administratio *Legislation, *Conservation, Water utilizatio Planning, Water resources, Public benefits, A ministrative agencies, Financing, Federal gover ment, Political aspects, Economics, Social aspect Legal aspects, State governments, Water pollutio Water pollution control, Public health.

The uses of water resources are becoming mo diversified and intensified. Economic planning ar investment is more important in the wat resources development area. The notion that o resources were unlimited no longer exists and leg provisions for resource protection are mo prevalent. Water is exhaustible and it does not le itself to substitution. There has also evolved public interest concept. Resource utilization is co sidered in terms of replenishment and destructio The administrative process in Wisconsin has led cooperation with government in the resources are Wisconsin's legislature and judiciary is discussed conjunction with the administrative proces

egislative appropriations are also covered. Cen-al administration in Wisconsin reveals effective ork without a single agency and without official nterest group representation in the agency. A pri-ary state interest lies in conservation. The com-ittee representing state agencies is discussed, as is e civil service tenure. Wisconsin compacts and ederal legislation is also mentioned. Federal and tate cooperation is urged, as is the thoughtful crea-on of administrative agencies to avoid abuse. olitical control agencies are necessary in the area f regulation of physical resources.
V68-01361

ASES OF RESOURCE REGULATION,
arl F. Murphy.
n Water Purity: A Study in Legal Control of Natu-al Resources, pp 3-22, Wisconsin Univ. Press, Iadison, 1961. 19 p, 37 ref.

Descriptors: *Wisconsin, *Water pollution control, History, *Water resources, Water utilization, Technology, Water management (Administrative), ndustrial wastes, Water pollution, Surface waters, Groundwater, Sedimentation, Water law, State overnments, Federal government, Legislation, dministration, Water quality control.

Resource utilization and regulation depends on the ondition of any given period of time. Eleventh and ineteenth century England comparisons serve as n example. England's impact on America is iscussed. Resources are either exhaustible rough use or replenishable. The rate of use of esources should be gauged in relation to echnological developments. A discussion of water onsumption follows. Water pollution adds to roblems of decreasing supply. Another problem as been irresponsible management. Two views of ater pollution control are discussed. Industrial aste is considered in terms of cost of abatement. While sediment is found naturally in all streams, limination of water pollution would reduce the arm from sedimentation. Water pollution and round waters are discussed. Water purity became legal concern of both state and federal govern-ents in the nineteenth century. While the equisites of quality control existed in the 1950's, ollution abounded. Greater governmental powers esulted. However, the Federal government referred to leave the work to the states. A survey f federal activity, both legislative and administra-ive, follows. The purpose of this book then is to ake a case study of water purification efforts in he state of Wisconsin.
W68-01362

CHANGES IN RESOURCE MANAGEMENT,
Earl F. Murphy.
n Water Purity: A Study in Legal Control of Natu-al Resources, pp 23-46, Wisconsin Univ. Press, Madison, 1961. 23 p, 63 ref.

Descriptors: *Water management (Administra-ive), *Water purification, *Wisconsin, *Water ollution control, History, Water pollution, Sewage, Industrial wastes, Technology, Public ealth, Profit, Environmental sanitation, Sewage reatment, Administration, Administrative agen-ies, Human diseases, Cities, Political aspects, Federal government.

The 19th Century can be studied to determine a vorld wide pattern as to water problems which car-ied over to the present. Industralization is crucial o this period. Wisconsin was market oriented, as a esult of the commercial revolution. Water became n exploited commodity; water pollution increased. Health is discussed. Major pollution sources were nunicipal sewage and industrial wastes. Technological developments met with resistance efore acceptance. This reluctance was charac-eristic of both private and municipal enterprises. The demand for purification came from the popu-ace, including women's leagues and writers. Loss of profits also impeded purification efforts. The ole of public health agencies in the area of sanita-tion is discussed. Sewage treatment was hampered by insufficient data and high costs. Taxpayers favored low cost programs. Industrial pollution control likewise suffered from economic and technological restraints. Another problem recognized in Wisconsin was a lack of public knowledge as to conditions and treatments. Political expedience was yet another hurdle to water purification, as was public apathy. The attitude of the American must be considered before embarking on any water resource development.
W68-01363

TRANSITION TO CENTRAL ADMINISTRATIVE CONTROL,
Earl F. Murphy.
In Water Purity: A Study in Legal Control of Natural Resources, pp 47-70, Wisconsin Univ. Press, Madison, 1961. 23 p, 70 ref.

Descriptors: *Wisconsin, *Administration, *Local governments, History, *Legislation, Water pollution, Water pollution control, Water purification, Water law, Mills, Administrative agencies, Sewage, Decision making, Cities, Water supply, Remedies, Judicial decisions.

Nineteenth century case law served as a restraint of water pollution, but only after litigation or damage was done. A large volume of statutes also existed, but they were inadequate. Earliest pollution control in Wisconsin was aimed at industry. However, legislation was often at the source of pollution such as in permitting mineral exploitation and pollution in return for rapid cash gains. The mill acts are discussed. English statutes aimed at industrial pollution control during this period are also covered. Pollution control was largely dependent on local efforts, despite the history of royal perogative. Reassertion of central authority was made possible by the power of the Legislature. The Wisconsin legislature enacted its policies via local board and officials. Legislation covered sewers, watercourses, public water systems, etc. Municipalities were given increasing responsibilities in purification areas. One of the unfavorable results of this emphasis on local activity was the problems of administration. The extent of central control was a recurring question. Heavy reliance on the judicial system resulted. But this merely raised new questions of administrative control and remedies at law. This inadequacy of the judicial process and remedy reawakened the need for central authority.
W68-01364

DEVELOPMENT OF CENTRAL ADMINISTRATING CONTROL,
Earl F. Murphy.
In Water Purity: A Study in Legal Control of Natural Resources, pp 71-94, Wisconsin Univ. Press, Madison, 1961. 23 p, 63 ref.

Descriptors: *Wisconsin, *Administration, *Legislation, *Water pollution, Water pollution control, Administrative agencies, Public health, History, Political aspects, Local governments, Water quality, Water purification, Sewage treatment, Conservation, Federal government, State jurisdiction, Cities, Water quality control, Recreation wastes.

The historical origins of central state agencies are introduced. After the Civil War, state health boards appeared as the first agencies, such as in Wisconsin in 1876, with the State Board of Health. This board suffered from insufficient public support, funds, and political interest. Reports by the Board showing pollution were ignored or attacked by municipalities and the public. Recommendations fell by the wayside. After the turn of the century, greater jurisdictional powers over water supply and sewage systems were given to the Board. Constant pressures eventually resulted in greater powers and new bureaus, such as sanitary engineering. In 1919, the Board's efforts resulted in a comprehensive water pollution act. Soil conservation and fisheries commissioners assisted the Board. A new conservation commission was created, which concerned itself with water pollution. Administrative difficulties which arose were solved by greater centralization. In 1933, attitude changes in the federal government furthered pollution control activities. But an impetus at the federal level faltered due to the diversion of war and complacency. The next phase of Wisconsin development centers on the activities of the Izaak Walton League of America. Legislation was the final product.
W68-01365

OPERATION OF THE STATE CENTRAL ADMINISTRATIVE AGENCY,
Earl F. Murphy.
In Water Purity: A Study in Legal Control of Natural Resources, pp 95-130, Wisconsin Univ. Press, Madison, 1961. 35 p, 91 ref.

Descriptors: *Wisconsin, *Administration, *Administrative agencies, *Water pollution control, Water pollution, Sewage, Foods, Forests, Forest management, Industrial wastes, Public health, Publications, Legislation, Judicial decisions, State jurisdiction, Conservation, Financing, Costs, Taxes.

Wisconsin pollution control rests with four state agencies governed by regulations growing out of a conscious division of responsibility, and a central committee. This interagency committee deals with each of the major polluters differently. Cost of pollution treatment is a constant problem. The major sources of pollution are domestic sewage, food products processors, and forest products processors. The state has aided treatment of wastes in industry with tax benefits. A discussion of the public service commission and the public health commission follows. Cooperation among the agencies and on the committee is also discussed with emphasis on the fact that all members are civil servants, thorough training, and diversity of backgrounds. Publicity is also emphasized. The committee relied on persuasion rather than coersion. One problem area is insufficient staffs to implement the legislative policies. Public relations was stressed in all dealings with industry and individuals, such as during hearings. The agencies have also desired to avoid conflict with judicial jurisdiction. Public apathy remained a problem for the committee.
W68-01366

PROGRESS REPORT.
For primary bibliographic entry see Field 03B.
For abstract, see .
W68-01367

A SHORT COURSE ON WATER LAW FOR THE EASTERN UNITED STATES,
Washington Univ, St. Louis.
Earl Finbar Murphy.
Wash U L Q, Vol 1961, No 2, pp 93-131, Apr 1961. 39 p, 178 ref.

Descriptors: *Watercourses (Legal), Riparian rights, Natural streams, Artificial watercoursed, *Reasonable use, Irrigation, Mill dams, Dams, Groundwater, Navigable waters, *Remedies, Prescriptive rights, Eminent domain, Massachusetts, New England, Atlantic coastal plain, Watersheds (Divides), Public rights, Population.

Existing water law reflects the context of its development: abundant community resources, short supply of capital, small population. In modern urban-industrial society these factors are radically altered. Response to new problems requires an understanding of the fairly clearly defined substantive law that has developed with respect to property interests of riparian owners. The author, relying primarily on Massachusetts case law, provides a general introduction by examining areas of special controversy in water use. A riparian owner today has at best a right to a stream's natural flow subject to reasonable use by other riparian owner's. Rights and duties with respect to pollution, irrigation and

damming of natural streams, navigability as a traditional basis for public interest in water use, the function of the watershed as a common geographical limit to water use by the riparian owner, and rules and problems pertaining to artificial watercourses and ground water are discussed in a general manner. The concluding section treats prescriptive rights, condemnation under eminent domain and suits in law and equity as means of enforcement of substantive rules. (MacMillan-Fla)
W68-01368

HEARINGS ON S4 BEFORE A SPECIAL SUBCOMMITTEE ON AIR AND WATER POLLUTION OF THE COMMITTEE ON PUBLIC WORKS, UNITED STATES SENATE.
For primary bibliographic entry see Field 05G.
For abstract, see .
W68-01370

TRANSFER OF RIPARIAN RIGHT TO USE WATER TO NONRIPARIAN LAND.
Lawyers Co-op, Rochester, N. Y.; Bancroft-Whitney Co., San Francisco, Calif.

14 A L R 330-339, 1921. 9 p (updated 54 ALR 1411).

Descriptors: *Riparian rights, Riparian waters, Riparian land, Competing uses, *Diversion, Water law, Legal aspects, Reasonable use, *Relative rights.
Identifiers: *Non-riparian land, *Transfer of rights.

A brief summary of the doctrine of riparian rights is given. It is stated that diversion of waters to non-riparian land should be limited to public purposes, and for which compensation is made to the riparian owners. The general rule is that a riparian owner can not convey more than his right to reasonable use of the water. Normally cases involving municipal water supplies are not based on riparian rights. Several cases involving municipalities and large public institutions are discussed. The majority of cases hold that a riparian right may not be used on non-riparian lands. Excerpts from cases with various fact situations, and which so hold, are set out. Three states, Massachusetts, New Hampshire, and Vermont, hold that water may be diverted by a riparian to non-riparian lands, provided it does not cause actual damage to a lower estate for present or future reasonable use. New Hampshire holds the only question to be that of whether the diversion is a reasonable use. Also, one Texas case allowed diversion by a non-riparian. This annotation is updated in 54 A.L.R. 1411. (R. F. Williams-Fla)
W68-01372

AGREEMENT IN RESPECT OF WATER RIGHTS IN STREAM AS CREATING A MERE PERSONAL OBLIGATION, COVENANT RUNNING WITH THE LAND, OR AN EASEMENT.

127 ALR, pp 835-848, 1940. 13 p.

Descriptors: *Judicial decisions, *Easements, *Riparian rights, Alteration of flow, Natural flow doctrine, Diversion, Water pollution, Water contracts, Legal aspects, Flow, Dams, *Water rights.
Identifiers: *Covenants.

The word agreement includes deeds, mortgages and leases. Easements appurtenant are incorporeal rights attached to some superior right and run with the land. An easement in gross is a mere personal interest in the real estate and is generally neither assignable nor inheritable. The various types of covenants are discussed. Generally, an instrument which imposes upon a riparian owner an obligation in connection with his riparian rights is held to be an easement appurtenant or a covenant running with the land. Cases holding instruments to create easements with regard to pollution, flowage, water power, raceways and other miscellaneous situations are discussed. Cases dealing with maintenance of dams and other works, and with unrestricted flow, where the agreement or instrument was held to be a covenant running with the land are next discussed. Instruments or agreements which are held to be mere personal agreements and not running with the land are discussed last.
W68-01373

RIGHTS AND DUTIES OF OWNERS INTER SE WITH RESPECT TO UPKEEP AND REPAIR OF WATER EASEMENT,
L. S. Tellier.
169 A L R, 1147-1157, 1947. 11 p, 4 ref.

Descriptors: *Judicial decisions, *Easements, Legal aspects, Water law, *Relative rights, Water contracts, Repairing, Maintenance.
Identifiers: *Water easements, *Dominant tenement, *Servient tenement.

The general rule, absent contrary agreement, is that the owner of land subject to an easement is under no duty to maintain or repair that easement. This duty falls upon the owner of the dominant tenement, and an unreasonable delay in making repairs may amount to an abandonment. The owner of the dominant tenement has a right to make a reasonable entry on the servient tenement to effect repairs or maintenance. This is often called a 'secondary easement,' and cases so holding are discussed. Where the water easement benefits only the owner of the dominant estate, he also has a duty to repair and maintain the easement. Under these circumstances, the servient owner is under no such duty. Where a project benefits both dominant and servient owners, generally they are each under a duty to care for that portion of the project which is on their land. Grants or agreements often establish the rights of the parties inter se, and several of the cases of this nature are discussed. Cases where the easement is mutually beneficial, but is governed by the terms of a grant or agreement, are discussed in conclusion.
W68-01375

TIDELANDS AND RIPARIAN RIGHTS IN FLORIDA,
Melvin J. Richard.
Miami L Q, Vol 3, No 3, pp 339-364, Apr, 1949. 26 p, 3 illus, 97 ref.

Descriptors: *Beaches, Tidal effects, Riparian rights, Accretion (Legal aspects), Alluvion, Avulsion, Bulkheads, *Florida.
Identifiers: Tidelands.

The question of ownership and property rights in tidal and submerged lands in Florida creates many problems because of the extensive coastline. The article covers applicable rules under common law, their influence on law in the United States the sovereign character of the original colonies with respect to tidal and submerged lands at the time of union, and rights acquired by states subsequently admitted into the union. Also discussed are federal government rights in tidal and submerged lands and the influence of Spanish law on the question in Florida. Florida case law and common law and case law of other jurisdictions on questions not ruled upon in Florida are collected. Questions of law reviewed are applied to a pending case involving title to and riparian rights in the beaches and ocean bottom in Miami Beach.
W68-01376

MICHIGAN'S PURLOINED SHORELINES,
State Bar of Michigan, Lansing.
George D. Haller.
Mich S B J, Vol 34, No 5, pp 36-39, May 1955. 4 p, 31 ref.

Descriptors: *Michigan, Great Lakes, Beds under water, *Ownership of beds, Beds, Legislation, Legal aspects, Judicial decision, Landfills, Land forming, Accretion (Legal aspects), State jurisdiction, State governments, Water policy, Water resources development.
Identifiers: Public trust.

Large numbers of riparian owners have extend their property by filling in the shallow water are over submerged beds of the Great Lakes in t State of Michigan. This intrusion by trespasse upon the public domain has become so prevale that legislation has been proposed to legitimati this illegality by permitting those occupying su land to purchase it from the state. This presen serious problems of policy and legality. The sta holds the submerged lands of the Great Lakes trust for the common benefit of all people. The p icy in Michigan has been to retain title to the be of the Great Lakes and not to alienate them. Wh judicial decisions have permitted leases of form submerged land which became dry by natur forces of reliction and accretion, the sale of su merged lands has been declared not within t state's power. The cases give no authority to t state to sell such areas which have been chang from submerged soil to dry upland by artific means, and the trusteeship of the state on behalf its citizens should not be permitted to be violat by private interests for private purposes.
W68-01377

ENGLISH WATER LAW DOCTRINES BEFOR 1400,
Temple Univ School of Law, Philadelphia.
Earl F. Murphy.
Am J Legal History, Vol 1, No 2, pp 103-118, A 1957. 16 p, 88 ref.

Descriptors: *History, Water law, Administratio Diversion, Public rights, Drainage, Floodin Transportation, Natural flow doctrine, Remedie Rivers, Streams, Ponds.
Identifiers: Medieval, England, Common law.

Legal writers and selected cased form the basis f a description of water law doctrine in medieval E gland. Rules regarding the right to an un-impede flow of water and rights concerning diversio drainage and pollution took shape in the 13th Ce tury and have continued as a part of common la Tortious interventions with a neighbor's rights co stituted actionable nuisances. Similar doctrines b fore the time of Bracton's introduction of civil la concepts are explained as necessary solutions problems of drainage and transportation. Cas reflect the King's attempts to keep river highwa unobstructed; the attempts were often feeble whe for example, the fish traps of a great landown whose support the crown needed to rule were question. What early writers had to say about t problems of property concepts and water law is r ported. The often confused division of responsibi ties between landowner, town, church and crow for the maintenance of banks, drainage ditche weirs, bridges and dykes is described.
W68-01379

REAL PROPERTY - RIPARIAN RIGHTS,
North Carolina Univ, Chapel Hill.
James A. Alspaugh.
N C L Rev, Vol 34, No 2, pp 247-253, Februa 1956. 7 p, 38 ref.

Descriptors: Water law, *Riparian rights, *Ripa an land, *North Carolina, Water RRIGHT Beneficial use, *Watersheds (Divides).
Identifiers: *Watershed rule.

The Supreme Court of North Carolina in the ca of Young v City of Ashville, 241 N C 619, 86 S 2d 408 (1955), raised two important and und cided questions by quaere: (1) What is the exte of riparian land; (2) Can a riparian owner transf his riparian rights to a non-riparian owner for u on non-riparian land. In discussing the problem raised by these questions, the article discusses t two principle theories concerning the physical e tent of riparian land. The first, the watershed rul limits riparian rights to land within the watershed a stream. The limits of riparian land under t second doctrine are common ownership and co tiguity to the stream. The author suggests that t

first rule is more closely in step with the policy of protecting the lower riparian owner while still allowing maximum usage of the riparian water. As to the second question raised by the above cited case, the majority of states that have considered the problem answer it in the negative, although some allow appropriation of surplus water for beneficial use on non-riparian land.
W68-01381

WATER RIGHTS IN IOWA,
Iowa State Univ.
Eugene Davis.
Iowa L Rev, Vol 41, No 2, pp 216-236, Winter 1956. 31 p, 95 ref.

Descriptors: Water law, *Iowa, Riparian rights, Riparian land, Diversion, Natural streams, Percolating water, Pollution abatement, Lakes, Irrigation, Consumptive use, Appropriation, Surface waters.

Court decisions form the basis for private water rights law in Iowa, a riparian state. Natural use - including watering livestock - is not limited; artificial use - including irrigation and use by municipalities - is limited by rights of other riparian owners. Municipalities have condemnation power, however. Pollution is a crime, gives rise to private action and also is subject to regulation by the state. In general rights in lakes and underground streams are the same as those in watercourses. An owner has an absolute right to surface water and the right to expell it from his land (common enemy) subject to the rights of his neighbor. Riparian rights can be severed from land by express conveyance; they are not lost by nonuse but right to natural flow may be modified by inaction. Prior appropriation doctrine has been recognized in cases involving the taking of ice from public streams which could be guideposts for legislation allowing members of the public to appropriate and use water from streams whose beds are owned by the state. Taking water from streams not public could raise constitutional problems.
W68-01384

WATER RIGHTS LAW IN KENTUCKY.
Kentucky Legislative Research Commission.

Water Rights Law in Kentucky, pp 1-75, Feb 1956. 75 p, 5 plate, 7 map, 3 tab, 83 ref.

Descriptors: *Kentucky, *Water law, *Riparian rights, *Water supply, Water utilization, Water users, Legislation, History, Judicial decisions, Prior appropriation, Reasonable use, Cities, Eminent domain, Water policy, Irrigation, Domestic water, Climatic data, Riparian land, Municipal water, Industrial water.

The study commences with the historical development of Kentucky's water law. Emphasis is on riparian rights and legislation, especially the Water Conservation Law of 1954. The more important provisions and the overall policies are discussed. The water supply of Kentucky is examined with emphasis on climatic conditions, the physiographic regions and the watersheds or river basins. Also covered is streamflow variations, droughts, availability of ground water and the law of ground water use. Kentucky water use is discussed by category, i. e., domestic water, municipal water, industrial water, and irrigation. Vital statistics on the volume of water being used in each category are included. The final chapter is devoted to possible alternatives to the Kentucky riparian rights doctrine. The prior appropriation doctrine's origins are considered, along with statuatory provisions in Western states. These states follow either an exclusive appropriation doctrine or a mixture of riparian and appropriation doctrines. The possible application of the appropriation doctrine in Kentucky is discussed with particular emphasis on the irrigation problems. The study concludes with some general historical remarks and an examination of the legislative policy and its relation to the legal alternatives.
W68-01385

WATER RIGHTS LAW IN KENTUCKY -- HISTORICAL DEVELOPMENT OF KENTUCKY WATER LAW.
Kentucky Legislative Research Commission.

Water Rights Law in Kentucky, pp 1-20, Feb 1956. 20 p, 53 ref.

Descriptors: *Kentucky, *History, *Legislation, *Riparian rights, Reasonable use, Natural flow doctrine, Judicial decisions, Water policy, Water law, Regulation, Domestic water, Impoundments, Prescriptive rights, Riparian land, Mills, Condemnation, Eminent domain, Cities, Prior appropriation.

Kentucky water law originated during a period when the major water use was domestic. In 1887, Kentucky judicially adopted the riparian rights doctrine. However, there is some question as to whether Kentucky has adopted the natural flow or reasonable use theory. Excerpts from the Restatement of Torts and judicial opinions on both theories are included. The Water Conservation Law of 1954 was the first general legislative pronouncement of water policy. It defines the scope of state regulation of public waters and exempts certain waters from regulation. Domestic uses have priority over all other uses. The reasonable use theory is stated. Impoundment rights are also covered. Prescription and adverse use are recognized in Kentucky by statute. Riparian rights are vested rights, dependent upon ownership of riparian lands. Kentucky also has a mill act which regards the taking of land as an exercise of eminent domain. The Kentucky Mill Act of 1797 is discussed. The amendments to this Act and the 1893 act are also discussed. Modern mill acts are largely obsolete, but they could represent the limits of legislative condemnation powers. A municipality also has a power of eminent domain.
W68-01386

WATER RIGHTS LAW IN KENTUCKY - ALTERNATIVE LEGAL APPROACHES.
Kentucky Legislative Research Commission.

Water Rights Law in Kentucky, pp 65-75, Feb 1956. 10 p, 10 ref.

Descriptors: *Kentucky, *Riparian rights, Water law, *Prior appropriation, Reasonable use, Legislation, History, Judicial decisions, Irrigation, Water users, Eminent domain, Permits, Water policy, Water supply, Domestic water, Water utilization.

The riparian and prior appropriation systems arose out of basic differences between physical and human relationships in the East and West. English common law recognized certain established uses. Blackstone's doctrine of prior occupancy is discussed in relation to riparian rights. Common rights are also discussed. The riparian rights doctrine is based on the Code Napoleon. The first American use of riparian doctrines came in 1827 and 1828. Prior appropriation doctrines originated in western mining camps. Western states are divided between exclusive prior appropriation laws and a combination of riparian and appropriation doctrines. The possibility of applying the prior appropriation doctrine in Kentucky is discussed, with emphasis on irrigation. The major drawback is the fact that water use under the appropriation doctrine is frozen in favor of irrigators, to the detriment of other potential users. Less than one per cent of water use in Kentucky is for irrigation. Liberal interpretation of reasonable use rules makes riparian rights severable from the land and transferable to nonriparians. Eminent domain, permits, and the California system are mentioned. Finally, the feasibility of the alternatives to the riparian doctrine are discussed in light of legislative water policy.
W68-01389

THE RIGHTS OF A RIPARIAN LANDOWNER IN MISSOURI,
Missouri Univ. School of Law, Columbia.
Donald Burrell, and Donald G. Stubbs.
Mo L Rev, Vol 19, No 2, pp 138-146, April 1954. 9 p, 30 ref.

Descriptors: *Missouri, *Riparian rights, Water law, Watercourses (Legal), *Natural flow doctrine, *Reasonable use, Water rights, Prior appropriation, Riparian land, Water policy.
Identifiers: *Reasonable use doctrine, *Water rights, History.

Since there is no direct judicial holding in Missouri as to what theory it will follow in adjudicating riparian rights, the law is somewhat obscure. In order to provide a foundation and background for a solution to this problem, the article discusses the history of riparian rights and presents arguments for and against adoption of the natural flow and reasonable use rules. Adoption of the prior appropriation theory is given little attention, due to constitutional difficulties and problems of administration. Argument for the natural flow theory is based primarily on the language of the cases dealing with water rights and the certainty of water rights under the rule. As to the reasonable use rule, it is argued that such a rule is consistent with the facts of the cases using the language of the natural flow doctrine; and thus there is no binding precedent for either rule in Missouri. Factors favoring adoption of the reasonable use rule include maximum flexibility, applicability to all situations, and ability to allow the fullest beneficial use of available water.
W68-01390

REAL PROPERTY - SURFACE WATERS COMMON ENEMY RULE AMPLIFIED,
Alabama Univ. School of Law.
William A. Sanders.
Ala L Rev, Vol 8, No 2, pp 410-416, Spring 1956. 7 p.

Descriptors: *Surface runoff, Water law, Watersheds (Divides), *Repulsion (Legal aspects), Surface waters, Riddance (Legal aspects), Reasonable use, *New Jersey, Judicial decisions.
Identifiers: *Reasonable use rule, *Civil law rule.

The article involves a commentary on the case of Yonadi v Homestead Country Homes, 114 A 2d 564 (N J 1955), which held that under the common enemy rule of surface waters (as distinguished from streams, lakes and percolating waters) increased run-off harming the plaintiff was not actionable, even though it resulted from a combination of development and channeling by artificial means. Both the common enemy and civil law rules of surface waters are discussed, the latter of which holds that one landowner may not interfere with the natural flow of surface water to the detriment of another. U S courts are about evenly divided as to which of the two rules is the better. Some courts have rejected both for the reasonable use rule, and few follow either of the two leading rules without modification. The author believes that a modified civil law rule would produce better results in the case cited above.
W68-01391

OWNERSHIP OF BEDS OF NAVIGABLE WATERS,
Tulane Univ., New Orleans.
Jamie E. Diaz.
Tul L Rev, Vol 30, No 1, pp 115-129, Dec 1955. 15 p, 91 ref.

Descriptors: Water law, *Legislation, *Louisiana, Judicial decisions, *Ownership of beds, Beds under water, Navigable waters, State governments, Patents.
Identifiers: *Constitutional aspects.

This comment concerns California Co v Price, 225 La 706, 74 So 2d 1 (1954), and Act 727 of 1954

which attempted to overcome its result. Louisiana law concerning ownership of beds of navigable waters is surveyed. The courts have held that private persons may acquire beds of navigable waters only by state patent. However, since 1921 the Louisiana Constitution has provided that beds of navigable waters are insusceptible of private ownership. This necessitates a decision by the courts as to which beds of navigable waters were susceptible to private ownership before 1921, in order to decide if patents granted before that date are valid. A curative act passed in 1912 established a six-year prescriptive period for actions by the state to annul or vacate patents. The California Co case (1954) held that this act barred the state from contesting a pre-1921 patent to the bed of an arm of the sea. Act 727 of 1954 stated that when the legislature passed the 1912 curative act, it didn't intend for it to cure patents to beds of navigable waters, and that such patents granted 'heretofore or hereafter' were null and void. It is concluded that this act is unconstitutional, leaving the law in this area in a state of uncertainty.
W68-01393

BOUNDARY PROBLEMS RAISED BY THE SUBMERGED LANDS ACT,
Columbia Univ., New York.
Aaron L. Shalowitz.
Colum L Rev, Vol 54, No 7, pp 1021-1048, Nov 1954. 28 p, 7 fig, 85 ref.

Descriptors: *Legislation, *Submerged Lands Act, Low water mark, *Ownership of beds, Beds under water, Bays, Inlets, Tides, Seashores, Federal-State water rights conflicts, *Boundaries (Property), Oceans, Coasts, Boundaries disputes, International law.
Identifiers: Marginal sea, Envelope line.

This article concerns seaward boundary problems posed by the Submerged Lands Act of 1953, which granted ownership of beds under navigable waters to the states. The seaward boundary is to be three miles (with exceptions) from the 'coast line' or the 'line of ordinary low water.' Bays and indentations present a problem. Are they inland waters (not included in the 3 miles) or open sea (included). The 'semi-circular rule' is suggested and explained, as it was used by the Special Master in U. S. V California (Submerged Lands Cases), and as it is used in international law. The offshore islands problem is discussed and it is pointed out that the Special Master concluded that such islands should not constitute a state's coast line, but that each should merely be given a marginal belt of its own. The technical problems of determining the ordinary low water mark are discussed, with the conclusion that the mean of all low tides should be used. The use of an 'envelope line' is found to be the most practical and reasonable method of those discussed to plot the seaward boundary.
W68-01394

THE MUNIMENTS OF TITLE OF MASSACHUSETTS TO HER SUBMERGED SEA LANDS,
Massachusetts Bar Assoc., Boston.
Richard Wait, Frank Grinnell, and William B. Sleigh, Jr.
Mass L Q, Vol 35, No 1, pp 1-62, March 1950. 62 p, 3 append.

Descriptors: Federal-state water rights conflicts, *Ownership of beds, Water law, *Massachusetts, Judicial decisions, Beds, *Continental shelf, Legislation, Oceans.
Identifiers: Three mile limit, Constitutional law.

The United States Supreme Court in the case of U S v California, 332 U S 19 (1947), held that the State of California was not entitled to lease out submerged lands in the Pacific Ocean between the low water mark and the three mile limit. In reaching this conclusion, the Court rejected California's argument that the original thirteen states acquired such lands from the Crown of England, and therefore California owned such lands by virtue of its being admitted into the Union on an equal footing with the original states. The authors of this article, members of the Massachusetts Bar Association, contest the part of the Court's ruling rejecting colonial ownership of the seabed out ot the three mile limit by setting forth title deeds and constitutional muniments of Massachusetts titles to such land. This is supplemented by historical and constitutional analysis complimentary to the authors' position.
W68-01395

AMERICAN WATER RIGHTS LAW,
South Carolina Univ., Columbia.
C. E. Busby.
SCLQ, Vol 5, No 2-A, pp 106-129, Dec 1952. 23 p, 132 ref.

Descriptors: *Prior appropriation, *Riparian rights, *California, Water law, Legal aspects, Judicial decisions, Civil law, Relative rights, *Competing uses, Legislation, State governments, Preferences (Water rights), Social aspects, Water rights.

Water problems arise because of too much or too little water. The source of water and the damage caused by it often arise in different localities or jurisdictions, causing additional problems. Early developments in England and France and their influence on the U. S. doctrine of riparian rights, as reflected by Kent and Story, are discussed. The article next traces the origin of the prior appropriation system from its origin in western mining camps. The Indian, Spanish and Mexican occupations of the West established the custom of irrigation. The gold rush and its influence on the law are discussed. Usually, the local mining customs were adopted as local law, and often this conflicted with the English common law which was adopted by each state as it joined the union. Explanations of the theory and development of the California doctrine (dual system of riparian and appropriative rights) and the Colorado doctrine (single appropriative rights system) are given with changing needs for, and uses of, water, the divergence between the two doctrines has narrowed. Specific developments in California, Oregon, Kansas and Colorado are related.
W68-01398

THE DEVELOPMENT OF RIPARIAN LAW IN ALABAMA,
Alabama Univ. School of Law.
Harold I. Apolinsky.
Ala L Rev, Vol 12, No 1, pp 155-173, Fall 1959. 19 p, 73 ref.

Descriptors: *Alabama, *Natural flow doctrine, *Riparian rights, *Reasonable use, Prior appropriation, Water law, Pollution abatement, Water pollution, Economic impact, Industrial wastes.
Identifiers: *Multiple polluters.

The purpose of the article is to discuss the development of the law of riparian rights in Alabama. The three principle riparian doctrines, natural flow, reasonable use and prior appropriation, are set forth and defined. Alabama rejected the prior appropriation doctrine at an early date and instead adopted the natural flow doctrine. This rule was well suited for Alabama's early economic climate, as its principle industry, milling, required a constant, dependable source of water. However, as the economic structure of the state began to change around 1800 with the advent of mining, manufacturing, and iron and steel industries, the courts began to indicate that the public interest in economic growth might override the riparian's right to natural flow. This led to application of the reasonable use rule to pollution cases and detention not causing flooding, with the natural flow concept still being applied to diversion. Several barriers to recovery for pollution damage by riparian owners, such as the multiple-polluter rule, are discussed. Legislation is recommended to solve the problem of recovering damages when multiple polluters are involved.
W68-01401

6F. Nonstructural Alternatives

CUCAMONGA CREEK, SAN BERNARDINO AND RIVERSIDE COUNTIES, CALIFORNIA (FLOOD CONTROL PROPOSAL).
U. S. Army Corps of Engineers, Wash., D. C., Office of Chief of Engineers.

U. S. 90th Congr, 2d Sess, House Doc No 323, 188 p, 1968. 2 plate, 3 append.

Descriptors: *Flood control, *Flood routing, *Hydrology, *Flood damage, *Flood plain zoning, Channel improvement, Cost-benefit ratio, Floodways, Levees, Rivers and Harbors Act, Historic flood, Maximum probable flood, California.
Identifiers: *Flood data, Flood frequencies, Damage frequencies, Alluvial fans, Artificial recharge (Floodwaters).

The flooding of Cucamonga Creek, San Bernardino and Riverside Counties, California, was studied by the Corps of Engineers, and proposals were made for flood control and floodplain management to reduce flood damage. Population in the overflow area is 26,000 and is increasing as part of the rapidly growing Los Angeles area. Repetition of the most damaging flood on record (in 1938) would now cost $15,000,000. Cucamonga Creek rises in the San Gabriel Mountains and flows over a large alluvial fan where it leaves its canyon. During intense rainfall, heavy loads of debris and silt are carried, and the alluvial channels shift rapidly. Urban floodplain development makes floods increasingly hazardous by reducing land area for safe spreading of floodwater and debris by construction of valuable structures in the path of flooding. Control proposals include construction of debris basins, diversion levees, artificial recharge facilities, and channel improvements. The benefit-cost ratio is estimated to be 1.6. Appendixes present data in the form of tables, graphs, maps and drawings for climate, topography, flooding, population trends, damage-frequency, discharge frequency, economic history, plans of action, and economic predictions. Comments by other government agencies are included as an appendix. (Knapp-USGS)
W68-01033

ECONOMIC ANALYSIS OF ALTERNATIVE FLOOD CONTROL MEASURES,
Kentucky Univ., Lexington. Dept. of Civil Engineering.
L. Douglas James.
Water Resources Research, Vol 3, No 2, pp 333-343, Second Quarter 1967. 11 p, 1 tab, 14 ref.

Descriptors: Flood plains, *Floodproofing, *Flood control, *Flood damage, Urbanization, *Nonstructural alternatives, *Computer models, Discount rate, Right-of-way, Land use, Cost-benefit ratio, Geographical regions, Streamflow.
Identifiers: Channel capacity, *Flood peaks, *Channel construction, Cost multipliers, Morrison Creek Watershed Tributary.

A digital computer program was developed to determine the optimum combination of structural and non-structural measures for flood control according to the criterion of economic efficiency. The program is readily applicable by any agency interested in analyzing the relative merits of structural and non-structural measures or in more rapid economic analysis of alternative channel improvement designs. The optimum combination of channel improvement, flood proofing, and land use control for each portion of the flood plain during planning stages of specified duration is selected by the program. It was also used to relate the optimum combination of the three measures to specific

flood-plain properties. Finally, the sensitivity of the nature and the total cost of the optimum program was related for various flood-plain conditions to variation in cost of channel improvement, cost of land use control, cost of flood proofing, right-of-way value, value of the coefficient relating flood damage to flood severity, value of open space preserved in an urban area, extent of aversion to irregular timing of flood damage, discount rate, population projections, and the exclusion of alternative combinations. (Seneca-Rutgers)
W68-01052

AVERAGE PROBABILITY OF EXTREME EVENTS,
U. S. Geological Survey, Washington, D. C.
Manuel A. Benson.
Water Resources Research, Vol 3, No 1, pp 225, First Quarter 1967. 1 p.

Descriptors: Insurance, Risks, *Floods, *Probability, *Flood damage.
Identifiers: *Average probability, 100-year flood level, 200-year flood stage.

The problem of accounting for risk in flood insurance purposes over a long period of time was approached by looking at the average probability of all floods over the 100-year level. The average probability of all such floods was found to be 0.005, or the probability of the 200-year flood. In general it could be shown that the average probability of all floods above the K-year flood is equal to 1/2 K. Further investigation, by use of assumed or experienced flood stage-damage relations, showed that damage computed for the 200-year flood stage is a good approximation to the average damage from all floods above the 100-year stage. A demonstration is presented for the average probability of all events that equal or exceed the K-year event. (Seneca-Rutgers)
W68-01059

SIMULATION OF A NATIONAL FLOOD INSURANCE FUND,
Florida Univ., Gainesville; Harvard Univ., Cambridge, Massachusetts.
John C. Schaake, Jr., and Myron B. Fiering.
Water Resources Research, Vol 3, No 4, pp 913-929, Fourth Quarter 1967. 17 p, 4 fig, 10 tab, 6 ref.

Descriptors: *Model studies, Floods, Rates, Flood damages, Flood plains, Management, Simulation analysis, Insurance.
Identifiers: *National flood insurance fund, Fund, MUSH, FISP, Discount coefficient, Reinsurance structure, Stationary process, TIC.

A model for simulating a national flood insurance fund is formulated. The objective is to model the fund and to specify optimal or near-optimal values of the premium rates, discount coefficients, initial capitalized value, and the reinsurance structure. The simulation model synthesizes flow traces and maps these into damages, collects premiums, indemnifies losses, collects reinsurance premiums from the insurance industry, and indemnifies that industry's excess losses. Relevant statistics that describe the behavior of the fund are accumulated. The mean and variance of simulated annual flood damages for the United States agree well with results of other studies. This agreement is encouraging in light of the paucity of systematically collected flood data in urban areas. Exponential growth in the variance of the fund over time was observed. This growth can be controlled by properly managing the fund. (Seneca-Rutgers)
W68-01062

(THE COMMERCE CLAUSE AND THE NAVIGATION POWER),
For primary bibliographic entry see Field 06E.
For abstract, see .
W68-01298

STATE FLOOD-PLAIN ZONING.

De Paul L Rev, Vol 12, No 2, pp 246-262, Spring-Summer 1963. 17 p, 100 ref.

Descriptors: *Illinois, *Flood plain zoning, Judicial decisions, Flood plains, Flood protection, Floods, Non-structural alternatives, *Local governments, State government, *Legislation, Flood damage, Zoning, Administration.
Identifiers: Constitutional aspects, Police power.

Flood-plain zoning is a recognized method of reducing damage, but to be effective, it should be administered at the state level. Man's choice of flood-plains as a habitat is the primary cause of flood damage. Flood-plain zoning is much like city or county zoning, an exercise of the police power, but since nearly all such ordinances have been enacted since 1949, cases on them are sparce. The two cases which do hold flood-plain zoning constitutional are discussed, and reasons for exercising this power are given. The ordinance must be 'reasonable,' with the principal criterion being the extent of the flood hazard, derived from engineering data. Lack of competent personnel and the impediment of vested interests call for a reversal of the trend of delegating responsibility for flood-plain zoning to lower level governments. Regional or state flood-plain zoning is advocated, and Hawaii's statute and a Tennessee proposal are examined. Illinois' delegation of this power to local governments is discussed and criticized. It is concluded that Illinois could, and should withdraw this delegation and handle flood-plain zoning at the state level. (R. F. Williams-Fla)
W68-01315

ZONING ON THE FLOOD PLAIN,
Edward Beuchert.
American Bar Assoc, Jour, Vol 49, No 2, pp 258-259, Feb 1963. 2 p, 10 ref.

Descriptors: Zoning, *Flood plain zoning, *Flood plains, Flood protection, Non-structural alternatives, Floods, Maximum probable flood, *Local governments, State governments, *Legislation, Flood forecasting, Flood damage.
Identifiers: Constitutional aspects, Police power.

Flood-plain zoning is a new concept in zoning. The flood plain is that area which will be inundated by the greatest flood reasonably to be expected in that region. Zoning of this area may be based on four reasons: (1) It is unwise to develop this area; (2) Obstruction of the flood-plain can cause damage to other property; (3) People are not aware of the danger; and (4) Flood damage results in public expenditures. Flood-plain zoning results from the view that protective works (dams, reservoirs, etc) are inadequate and expensive, and that damage can be more effectively reduced by restricting the use of the flood-plain itself. The restrictions in each zone would be based upon the frequency of inundation. A problem with such ordinances is that they are frequently roughly drafted and inadequately enforced. Acquisition of sufficient data is necessary, and federal and regional agencies are willing to help with this undertaking. It is concluded that there should be no problem with the constitutionality of flood-plain zoning as an exercise of the police power. (R. F. Williams-Fla)
W68-01316

6G. Ecologic Impact of Water Development

SOUTHWESTERN FISHES AND THE ENIGMA OF 'ENDANGERED SPECIES',
Arizona State Univ., Tempe; Desert Research Institute, Nevada Southern Univ., Las Vegas.
W. L. Minckley, and James E. Deacon.
Science, Vol 159, No 3822, pp 1424-1432, March 1968. 9 p, 3 fig, 2 tab, 44 ref.

Descriptors: *Fish populations, Fish management, Arizona.

A discussion is given on the decline in the populations of native fishes in the American Southwest. The habitats and status of 34 species of fish found in Arizona were discussed in the paper. It was concluded that habitat changes, associated with man's modification of various aquatic environments were responsible for endangering several of fish native to the Southwest. Native aquatic animals of the southwest are unique and endemic, part of an ancient relic fauna that can provide important scientific information if saved. (Affleck-Ariz)
W68-01102

AN ECOSYSTEMS APPROACH TO PUBLIC LAND POLICY,
Indiana University, Bloomington.
Lynton K. Caldwell.
Pap, 10th Annu West Resour Conf, Colorado State Univ, July 1968. 20 p.

Descriptors: *Ecology, *Public land, *Policy matters, Land resources, Environment, Biology, Land utilization, Natural resources, *Land management, Land ownership, Land development.
Identifiers: *Ecosystems, Public benefits, *Public land policy.

A public land policy restricted to lands in governmental ownership has been politically expedient but ecologically unrealistic. The natural processes of physical and biological systems comprising the land do not necessarily accommodate themselves to the artificial boundaries and restrictions that law and political economy impose upon them. The stress of human demands upon the land tends to displace natural processes throughout its ecosystems and to impair its capacity for self-renewal. American public land policy is based upon a set of historically derived assumptions (legal, economic, and political) that makes no provision for considering the fundamental ecological context of land use. Coping with land problems within the conventional context of public attitude, law, and economic arrangement is necessary, inadequate though it may be. Knowing that a larger context for policy exists for man to reckon with is also important. Present assumptions must be discarded for a policy of public management of human environment on ecologically valid principles if human demands upon the natural environment continue to mount. Then public land policy would be public policy for all land, and traditional rights of ownership would be modified greatly.
W68-01206

07. RESOURCES DATA

7A. Network Design

WATER DATA FOR METROPOLITAN AREAS,
U. S. Geological Survey.
William J. Schneider.
U. S. Geol. Surv. Water-Supply Pap 1871, 1968. 397 p, 3 fig, 5 tab, 32 ref. in introd and list of ref with each state.

Descriptors: *Data collections, *Hydrologic data, *City planning, *Urbanization, *Water resources, Industries, Utilities, Development, Population.
Identifiers: *Standard Metropolitan Areas.

The hydrologic data available by states and for each standard Metropolitan Area in the U. S. are cited, and references to their sources are given. Such data are prerequisite for planning and engineering design of urban environments. For each of the 222 areas, the information given consists of: (1) data on size and population, (2) a short description of the hydrology of the area, (3) a tabulation of current data-collection activities and data available in the area, (4) a list of current U. S. Geological Survey investigational projects in the area, and (5) a bibliography of reports on the hydrology of the area. (Knapp-USGS)
W68-01027

AUTOMATED WATER QUALITY MONITORING,
Fed. Water Pollut. Contr. Admin., Cincinnati, Ohio.
For primary bibliographic entry see Field 05A.
For abstract, see .
W68-01049

EXAMPLES OF RECENT ADVANCES IN ANALYTICAL TECHNIQUES FOR EVALUATING AQUIFERS,
U S Geological Survey, Water Resources Division, Denver.
Robert W. Stallman.
Pro of Nat Symp on Ground-Water Hydrol, Nov 6-8, 1967, pp 126-134, 1967. 9 p, 4 fig, 18 ref.

Descriptors: *Aquifer characteristics, *Hydrogeology, *Analysis, *Analytical techniques, *Research and development, Boundaries (Surfaces), Groundwater, Hydraulics, Drawdown, Groundwater barriers, Porosity, Specific capacity, Specific yield, Water table, Computers, Digital computers, Analog computers.
Identifiers: *Pumping-test data reduction, Analytical hydrology, Current status review.

The current state of analytical techniques for determining transmission, storage, and boundary conditions of aquifers is reviewed. Both cost and risk in the development of water supplies may be reduced by their use, and more complicated flow systems can now be analyzed at reasonable cost. Leaky artesian systems, unconfined vertical flow, delayed release from storage, and dewatering may be analyzed in pumping tests. Specific storage and porosity may be calculated from water level changes caused by earth tides and seismic disturbances. Analog and digital computers are used to solve boundary problems. Changes of storage in pumping tests can be monitored with neutron-scatter devices. Radiochemical dating of groundwater and radioactive tracers yield data about groundwater movement, and it is possible that other approaches, such as temperature distribution profiles, might be less costly. Study of the economy of data collection and reduction is necessary to determine what and how much needs to be done in any investigation to produce optimum results for reasonable cost. (Knapp-USGS)
W68-01118

GENERAL PROCEDURE FOR GAGING STREAMS,
U. S. Geological Survey.
R. W. Carter, and Jacob Davidian.
Tech of Water-Resources Invest of U S Geol Surv, Chap A6, Book 3, 13 p, 10 photo, 5 ref.

Descriptors: *Stream gages, *Instrumentation, *Discharge measurement, *Flowmeters, *Gaging stations, Current meters, Discharge (Water), Water levels, Hydrographs, Streamflow, Water measurement, Dye releases.
Identifiers: *Stream gaging.

The objectives and procedures for obtaining streamflow records are described briefly in a general introduction to a series of subsequent chapters on the specific topics covered. In 1967 the U S G S stream gaging network comprised about 9,000 continuous-record stations and 7,200 partial-record stations. The data are used to evaluate water resources, predict floods, and design structures. Topics covered are: general objectives and procedures; selection of gaging sites; artificial controls; measurement of stage; method of sensing stage; water-stage recorders; reference gages; discharge measurements by current-meter, indirect, and dilution methods; discharge ratings; computation and preparation of discharge records; and publication of records. (Knapp-USGS)
W68-01138

NEW DISTRIBUTIONS OF EXTREME WINDS IN THE UNITED STATES,
Environmental Science Service Administration, Silver Spring, Md.
H. C. S. Thom.
Proc Amer Soc Civil Eng, J Struct Div, Vol 94, No ST7, pp 1787-1801, July 1968. 15 p, 8 fig, 4 tab, 8 ref, 2 append.

Descriptors: *Wind (Meteorology), *Wind speed, Structural engineering, *Structural design, Probability, Nomographs, Storms, Buildings, Design data, Structural analysis, Design criteria, Statistical analysis, Maps.
Identifiers: *Wind velocity, Winds, Wind measurement.

Annual extreme wind speed data series were extended with recent records at airports and reduced to the standard 30-ft elevation. These were fitted by the Fisher-Tippett Type II (Frechet) distribution with a logarithmic transformation of the Type I distribution. Isotach maps are given for the 2-, 10-, 25-, 50-, and 100-yr mean recurrence intervals. A map for the 50-yr interval for Alaska and tabular data for Hawaii and Puerto Rico are included. Confidence limits on mean recurrence intervals are extended to the new record length and fixed-interval probabilities are discussed. A nomogram is included for power law elevation-speed conversion for powers of 1/7, 1/5, and 1/3. (USBR)
W68-01200

HYDROLOGIC DATA: 1966; VOLUME 3--CENTRAL COASTAL AREA, APPENDICES A-E.
California Department of Water Resources.
For primary bibliographic entry see Field 02A.
For abstract, see .
W68-01259

HYDROLOGIC DATA: 1966; VOLUME V--SOUTHERN CALIFORNIA, APPENDICES A-C.
California Department Water Resources.
For primary bibliographic entry see Field 02A.
For abstract, see .
W68-01260

7B. Data Acquisition

WATER LEVEL PROBE,
National Reactor Testing Station, Idaho Falls, Idaho, Health Service Lab.
K. H. McGary, M. Wilhelmsen, and P. Boren.
J Hydrol, vol 6, no. 3, pp 225-236, Aug 1968. 11 p, 8 fig.

Descriptors: *Instrumentation, *Water levels, *Conductivity, Liquids, Floats, Fluctuations, Measuring instruments, Design, Data collections, Automation, Surface tension, Electronics, Equipment.
Identifiers: *Well probes, *Sensing recorder, Industrial application, Magnetic compounds.

A recording instrument is described that was designed to use water conductivity as the sensing mechanism for percise measurements of water level changes in small pipes. Pictures, sketches, and descriptions are given of instrument models built to test several probes. One model has the advantage of a single-conductor shielded cable; another model has 2 limit switches that limit the overall probe travel to 12 ft. This prevents excessive cable letout or takeup in case of probe or electronic failure. The mercury switch is delicate and must be handled with care. This probe with sealed switch and float is expecially suitable for operating in clean industrial plants where liquids are nonconductive. By constructing float and probe case of nonmagnetic and nonsparking metals the instrument can be used in control and indication of flammable liquid levels. (Lang-USGS)
W68-01021

SELECTIVE ION ELECTRODE SYSTEM FOR FLUORIDE ANALYSIS,
Foxboro Co., Foxboro, Mass.
Russell H. Babcock, and Kenneth A. Johnson.
J Amer Water Works Ass, Vol 60, No 8, pp 953-961, Aug 1968. 9 p, 9 fig, 1 tab, 13 ref.

Descriptors: *Analytical techniques, *Test procedures, *Fluoridation, Monitoring.
Identifiers: Fluoride measuring electrode, Solid-state membrane, Crystalline membrane.

This conference paper describes the advantages and widespread use of a selective ion electrode system for fluoride analysis. A glass pH electrode and the solid-state membrane electrode for fluoride measurement are illustrated. The pH electrode uses a special kind of glass membrane that is very sensitive to hydrogen ions; the fluoride measuring electrode, a solid-state membrane. The composition of the crystalline membrane, sealed into the tip of the electrode with a watertight epoxy cement, determines the degree of ion selectivity. An equation is derived to show the relationship between measured potential and ion activity. The effects of temperature and pH on the fluoride measurement are outlined. The electrode measurements were compared with results from the distilled SPADNS technique, the most commonly used colorimetric method for fluoride determination. It is expected that the fluoride monitoring system will be faster, and more economical due to the continuous feedback control of fluoridation for close regulation and resultant savings in chemicals. (Llaverias-USGS)
W68-01116

THE ADJUSTMENT OF RADAR ESTIMATES OF STORM MEAN RAINFALL WITH RAIN GAGE DATA,
Illinois State Water Survey, Urbana, Illinois.
For primary bibliographic entry see Field 02B.
For abstract, see .
W68-01180

ELECTRICAL WATER LEVEL AND FLOW INDICATION AND CONTROL,
J. L. Watts.
Water Water Eng, Vol 72, No 868, pp 235-239, June 1968. 5 p, 10 fig.

Descriptors: *Flow control, *Floats, Float wells, *Flow meters, Water measurement, Discharge measurement, Electric switches, Instrumentation, Flow, Photoelectricity, Ultrasonics, Control, *Control systems.
Identifiers: *Water level, Great Britain, Flow measurement, Flow rate.

Many electrical, electro-magnetic, and electro-pneumatic devices are available to indicate, record, and control the water level in a tank or well, or to measurement flow rate. Among these are float-operated and pneumatic switches, water conductivity switches, photoelectric and ultrasonic switches, water level indicator switches, stepless level indication and recording, hydrostatic level indication and recording, photoelectric controls, capacitive level indicators, force-balance water level indicators and transmitters, and flowmeters. Details of the operation of many of the devices are given. (USBR)
W68-01238

MANGLA INSTRUMENTATION,
Binnie and Partners.
A. L. Little.
Water Power, Vol 20, No 7, pp 257-265, July 1968. 9 p, 12 fig, 1 tab, 7 ref.

Descriptors: *Instrumentation, *Earth dams, Hydraulic structures, Spillways, Tunnels, Pressure gages, Pressure sensors, Slope indicators, Piezometers, Settlement, Plumblines, Tunnel pressures, Costs, Foreign construction, Seismographs, Foreign projects.
Identifiers: *Mangla Dam, Pakistan, Seismic studies.

Details are given of the instrumentation of the main civil engineering structures, experience gained, and

results obtained. Principal instrumented structures are Mangla Dam; Jari Dam and rim works; and Sukian Dam, main spillway, and diversion-power tunnels. Total cost of instrumentation including installation was $799,200. Eight groups of five cells were installed to measure total pressure in each of five directions. Only two cells are functioning well enough for useful results to be obtained. Four types of piezometers used were hydraulic, electrical, Casagrande pot, and Casagrande pot with air bubbles. Additional fill material required by settlement was measured separately because of the large volumes involved. Foundation and fill settlements were measured with Bureau of Reclamation-type gages with crossarms at 10-ft intervals. Slope indicators were installed in the main dam and sensitive area around the intake. Five pairs of plumblines have been installed in the headworks of the main spillway. A seismic station was established between Mangla and Jari. (USBR)
W68-01239

ULTRASONIC METHOD OF FLOW MEASUREMENT,
H. Suzuki, H. Nakabori, and M. Yamamoto.
Water Power, Vol 20, No 7, pp 266-269, July 1968. 4 p, 9 fig, 1 tab.

Descriptors: Flow meters, Fluid flow, Penstocks, *Ultrasonics, Sonic waves, *Discharge measurement, *Acoustics, Measuring instruments, Water meters, *Velocity meters, Turbines, Velocity, Acoustic equipment, Test procedures, Underwater sound, Instrumentation.
Identifiers: *Acoustic velocity meters, Foreign testing, *Ultrasonic flow measurement, Japan, Flow measurement, Product evaluation.

Japanese experiences with ultrasonic flow measurements in penstocks for turbine tests are reported. Pitot tube, Ott current meters, and the Gibson methods of flow measurement are expensive, require emptying the penstock before testing, and are not practical for routine work. Ultrasonic methods do not require emptying the penstock. The specific method investigated is the sing-around system. Operation principles and test results of this system are discussed. The main conclusions are: (1) measurements are stable and repeatable; (2) ultrasonic probes can be externally attached to the penstock by magnets, and do not interfere with turbine operation; (3) only one worker is needed to perform measurements; (4) instruments are small and portable; (5) results can be calculated quickly; and (6) flow rates may be integrated or recorded separately. (USBR)
W68-01240

ROCK MECHANICS INSTRUMENTATION IN TUNNELS,
J. B. Sellers.
Water Power, Vol 20, No 7, pp 272-276, July 1968. 5 p, 7 fig, 17 ref.

Descriptors: *Rock mechanics, *Tunnels, *Tunnel pressures, Rock bolts, Tunnel linings, Tunnel design, *Instrumentation, Safety, Bibliographies, Rocks, Rock excavation, Field tests, Strain measurement, Strain gages, Deformation, *Pressure sensors, *Pressure gages, Dynamometers.
Identifiers: Jacking tests, Rock properties, In situ tests, In situ rock, Deformation modulus, Load cells.

Rock mechanics instrumentation is used to provide basic data for designing tunnels and supports and to provide data for controlling safety and economy of tunnel supports during excavation. Some measurement techniques are described. Two major problems in rock mechanics instrumentation are the difficulty in obtaining reliable data and analyzing the data in relation to the inherent variability of rock when considered as a structure. The best way to measure inherent stresses is by the strains they produce; this is done by the strain-relief overcoring method. Measuring the modulus of deformation in the field is valuable because a larger volume of rock can be tested and the mass behavior of rock studied. Jacking tests and dilatometers are discussed. Instruments that measure pressure changes and deformations in the rock and tunnel supports during excavation are necessary to control safety and economy of the supports. Some instruments used are hydraulic gages, rigid inclusion gages, load cells, and rock-bolt dynamometers. The extent of the loosening zone around the tunnel is the most important rock-mass movement that needs measuring. (USBR)
W68-01241

7C. Evaluation, Processing AND Publication

EXPRESSION OF THE UNCERTAINTIES OF FINAL RESULTS,
National Bureau of Standards, Washington, D. C.
Churchill Eisenhart.
Science, Vol 160, No 3833, pp 1201-1204, June 1968. 4 p, 6 ref.

Descriptors: *Errors, Estimating, *Measurement, Standards, Boundaries, *Experimental data, Mathematics, Test procedures, Measuring instruments, Materials testing, Reliability, Statistics, Methodology, Values.
Identifiers: *Data presentation, *Accuracy, Standard deviation.

Reported values of measurements need clear statements of the associated uncertainty for critical evaluation. A reported value of unknown accuracy is worthless. The specific error of a reported value is usually unknowable; however, limits to the error can be inferred from the precision of the measurement process. Uncertainty is indicated by stating credible limits to the likely inaccuracy. No single form for expressing these limits is universally satisfactory; different expressions are recommended depending upon imprecision, likely bias, and intended and other uses of the reported value. Four distinct cases discussed are: (1) negligible systematic error and negligible imprecision; (2) systematic error not negligible and imprecision negligible; (3) systematic error and imprecision not negligible; and (4) negligible systematic error and imprecision not negligible. Specific recommendations are given for each case. They call for more detail than is found in common practice, and they should be regarded as minimum standards of good practice. (USBR)
W68-01204

A FLEXIBLE COMPUTER PROGRAM FOR EVALUATION OF EMISSION SPECTROMETRIC DATA,
Woods Hole Oceanographic Inst.
Geoffry Thompson, Frank T. Manheim, and Kay Paine.
Woods Hole Oceanogr Inst Reference No 68-26, 95 p, Apr 1968. Unpublished Manuscript.

Descriptors: *Chemical analysis, *Spectrometers, *Computer programs, *Data processing, *Digital computers.
Identifiers: *Fortran, *Spectrometer data reduction.

A single program was designed to be used with a direct-reading emission spectrometer to reduce data from a variety of sample types, excitation methods, and concentration ranges. It corrects background by the linear relation of background to signal intensity at the line wavelengths measured. Background, internal standard, a analytical channels are used interchangeably. Either standard-dilution or variable-composition standards may be used. Curve-fitting is by least squares regression as high as 6th order in order to utilize shoulder and toe areas without distorting straight-line segments. Corrected sample readout is the dependent variable. The program is sensive to a few points greatly in error, for instance from transcription error in key punching. Ocassionally results require the analyst's judgement. A flow-chart and QUASP 2 fortran listing of input, program, output, and operating instructions are included. A test case is presented. (Knapp-USGS)
W68-01252

08. ENGINEERING WORKS

8A. Structures

LAND SUBSIDENCE ALONG THE DELTA-MENDOTA CANAL, CALIFORNIA,
U. S. Bureau of Reclamation, Sacramento, Calif.
N. P. Prokopovich, and D. J. Hebert.
J Amer Water Works Assoc, Vol 60, No 8, pp 915-920, Aug 1968. 6 p, 11 fig.

Descriptors: *Land subsidence, *Settlement (Structural), *Groundwater mining, Confined water, Canal design, Damages, Submergence, California.
Identifiers: *Delta-Mendota canal, *Active subsidence, Canal rehabilitation, Engineering.

The engineering importance and subsidence effects along the last 30-40 mi of the Delta-Mendota Canal, California, is briefly discussed. One of the most common causes of land subsidence is an overdraft of 'confined' or artesian groundwaters, or a condition in which pumpage exceeds recharge. The Delta Canal's maximum design capacity is 4,600 cfs or 2,000,000 gpm; the invert grade is only 3 in./mi. Water delivery started in June 1951, but the canal has been virtually idle in winter. The design of the canal did not provide for future subsidence which in 1951-52 exceeded 6 ft. In areas of maximum subsidence, bottoms of bridges actually became submerged; a few timber bridges became partially flooded in fall, 1966. Although no repair work in recent years has been done by the Bureau of Reclamation, a general rehabilitation program is proposed for fiscal 1968-69. (Llaverias-USGS)
W68-01127

SCOUR AND FILL IN ALLUVIAL CHANNELS WITH PARTICULAR REFERENCE TO BRIDGE SITES,
U. S. Geological Survey.
D. M. Culbertson, L. E. Young, and J. C. Brice.
U S Geol Surv Open-File Rep, 58 p, 1967. 14 fig, 1 tab, 35 ref, 1 append.

Descriptors: *Scour, *Bridges, *Abutments, *Piers, *Alluvial channels, Erosion, Channels, Stream erosion, Mathematical studies, Mathematical models, Civil engineering, Washouts, Channel morphology, Flood plains, Meanders.
Identifiers: *Scour prediction, *Bridge site engineering, *Fill.

The current knowledge of the behavior of alluvial channels as it applies to bridge site design and the problem of predicting scour and fill at highway crossings are discussed in detail. Mathematical methods for calculating the scour caused by simple gradual constrictions or estimating maximum probable scour at abrupt constrictions at piers are presented. It is concluded that, in general, methods of predicting scour are uncertain and development of more reliable methods requires the collection and appraisal of additional field data. Part I is an extensive discussion of scour and the causes of changes in scour and fill. Part II presents the current mathematical methods for calculation of scour. Part III presents suggestions for the preparation of case histories on scour and fill. An appendix outlines a scheme for classification and description of alluvial channels. (Knapp-USGS)
W68-01139

A PROBLEM OF OPTIMIZING A COLLECTING RESERVOIR SYSTEM,
Technion, Israel Institute of Technology, Haifa.
B. Avi-Itzhak, and S. Ben-Tuvia.
Oper Res, Vol 11, No 1, pp 122-136, Jan-Feb 1963. 15 p, 6 fig, 1 ref, 1 append.

Descriptors: *Reservoir design, *Statistical models, Optimization, Pumping, Correlation analysis, Economic feasibility.
Identifiers: Negative exponential distribution, Erlang distribution, Dam theory, Inventory model.

A collecting reservoir design problem was structured and analyzed using inventory theory. The daily input into the reservoir was approximated by the negative exponential distribution and the pumped output was continuous. The objective was to find the combination of reservoir size and pumping capacity that will utilize a certain quantity of water at a minimum cost. A mathematical model was presented. An example using actual data was solved graphically and presented. Four assumptions were made to find the solution: (1) inflows were not serially correlated; (2) within a time period the rate of outflow was constant; (3) inflow occurred during the winter only; and (4) the system operated under steady state conditions. The assumption of continuous pumping was relaxed in the appendix.
W68-01151

SUBMARINE PIPELINES,
Land and Marine Contractors Ltd, Great Britain.
J. M. Reynolds.
Pipes Pipelines Int, Vol 13, No 5, pp 22-36, May 1968. 10 p, 8 fig, 4 photo, 20 ref.

Descriptors: *Pipelines, *Submergence, Design, Construction, Concrete pipes, Steel pipes, Installation, Aluminum, Reinforced concrete, Scour, Linings, Prestressed concrete, Dredging, Protective coatings, Foreign construction, Waves, Wave action, Bibliographies, Glass fibers, Pipes, Hydraulic conduits, Pressure conduits, *Underwater.
Identifiers: *Submarine pipelines, Great Britain, *Pipe laying, Pipe design, Jetting, Wave energy, Plastic pipes.

The main features and principles of design and construction of submarine pipelines are given. This operation is done either on land or afloat on a barge because jointing cannot be done on the seabed. Moving the pipeline from the construction location to the seabed results in considerable stressing in the pipe; consequently, the design must be related closely to the method of installation. Installation is done by the pulling, lay barge, or floating and sinking methods. Pipeline burial is done by dredging, ploughing, jetting, or a combination of these methods. Principal design factors discussed are: (1) security against forces of waves, tidal currents, and seabed movement; (2) ability to withstand stresses; and (3) method of laying and buring. Characteristics of the materials suitable for construction (steel, aluminum, prestressed concrete, plastics, and fiberglass) are discussed. Various protective coatings are evaluated. Areas of needed research on submarine pipelines are suggested. (USBR)
W68-01199

ROD REINFORCEMENT OF TUNNEL TYPE EXCAVATIONS,
All Union Scientific Tech. Inst. of Hydrotechnology.
L. A. Petrov, and D. D. Sapegin.
Translation from Russian. Bur Reclam Transl 760, July 1968. 16 p, 6 fig, 7 ref.

Descriptors: Tunnels, *Rock bolts, Elastic theory, Fissures, Foreign design practices, Elastic deformation, Plastic theory, *Rock mechanics, Plastic deformation, *Tunnel design, Tunnel linings, Reinforcing, Field tests, Tunnel pressures, Cracks, Cohesion, Shear resistance, Pressure sensors, Stress distribution, Gunite, Underground powerplants.
Identifiers: Limit analysis, USSR, Tunnel supports.

Principles for designing roof reinforcement using rock bolts are outlined. Rock reinforced by rock bolts is regarded as an arch to be tested for strength and slippage along crack planes. Data on rock formations can be obtained by conducting large-scale field tests under natural conditions. Tests at 3 projects in USSR have shown that cohesion along fissures does not exceed 3 to 5 kg per sq cm. Deformations along fissures generally are irreversible, even with low slippage at contact surfaces. Deformation of a rock mass is pseudo-plastic and the theory of elasticity should be applied with reservations when evaluating rock pressures. Formulas are given for analyzing the arch according to the limit state theory. Data and recommendations are presented for roof reinforcement by various types of rock bolts. This reinforcement permits a tunnel to be driven at full cross section, and may be combined with or eliminate the lining. (USBR)
W68-01201

STRUCTURAL BEHAVIOR MEASUREMENTS FOR PENSTOCKS THROUGH CONCRETE DAMS HUNGRY HORSE AND CANYON FERRY DAMS,
Bureau of Reclamation, Denver, Colo.
Louis H. Roehm.
Bur Reclam Dams Br Rep No DD-7, Apr 1968. 36 p, 22 fig, 2 tab, 4 ref.

Descriptors: *Penstocks, Reinforcing steel, Strain measurement, Liner plates, Stress, Concrete dams, Instrumentation, Circumferential stress, *Structural behavior, *Pressure conduits, Computation, Linings, Outlet works.
Identifiers: Hungry Horse Dam, Mont, Canyon Ferry Dam, Mont, Missouri River Basin Proj, Strain meters.

During construction of Hungry Horse and Canyon Ferry Dams, instruments were installed on penstock liners and on the circumferential reinforcement around the liners. The purpose of these installations was to obtain structural behavior measurements that would indicate stresses and temperatures developed in the liners and reinforcement during operation of the penstocks. Measurements were made during a 10-yr period. Stresses based on these measurements indicate that 7 to 30% of the total static head is resisted by the liners. Liner and reinforcement stresses varied from 5-ksi compression to 10-ksi tension during the measurement period. Seasonal temperature changes at Canyon Ferry Dam caused liner and reinforcement stress changes greater than stress changes produced by changes in penstock pressure head. Stress plots showed no appreciable stress changes in the penstock liners or reinformcment due to sustained loading. (USBR)
W68-01222

ANALYSIS OF THE STABILITY OF COFFERDAMS WITH DOUBLE SHEET WALLS ACCORDING TO FIELD AND MODEL TESTS,
Gdansk Technical University, Poland.
Boleslaw Mazurkiewicz.
Arch Hydrotech, Vol 12, No 2, pp 93-130, 1965. (Transl from Pol, Tech Transl 67-56072, 1968.) 38 p, 25 fig, 4 tab, 48 ref.

Descriptors: *Cofferdams, Structural analysis, Stability analysis, Model tests, Field tests, *Sheet piling, Bibliographies, Safety factors, Foreign design practices, Rock foundations, Foundations, Dam failures, Horizontal loads, Failure (Mechanics), Earth pressure, Hydraulic models, Laboratory tests, Rupturing.
Identifiers: Stability, Stability coefficient, Hager method, Foreign research, Brinch Hansen method, Poland.

No generally accepted method of stability computation of cofferdams has been developed. A study was made in Poland to: (1) obtain data on parallel sheet piling cofferdam behavior, (2) analyze methods of stability computation, and (3) evaluate applicability of previous research results to this type of cofferdam. Laboratory tests and field studies were conducted. Results showed that for stability computation of cofferdams of this type founded on earth with different parameters of fill and foundation, Hager's method was best when uniform distribution of shear stresses and an admissible safety coefficient of 1.7 were assumed. The Brinch Hanson method was best for cofferdams founded on earth with equal fill and foundation parameters. For designing the sheet piling wall, the pressure coefficient of the fill against the piling which will cause the most unfavorable condition should be selected. A table is given of stability coefficient values computed by different methods for various cofferdams on rock and earth foundations. Design parameters are suggested that will permit developing a better technique for designing parallel sheet piling cofferdams. (USBR)
W68-01228

8B. Hydraulics

SUBCRITICAL FLOW OVER HIGHWAY EMBANKMENTS,
Utah State Univ., Logan Water Research Lab.
Gaylord V. Skogerboe, and M. Leon Hyatt.
ASCE Proc, J Hydr. Div., Vol 93, No. HY6, Pap 5564, pp 65-78, Nov 1967. 14 p, 7 fig, 3 tab, no ref.

Descriptors: *Open channel, *Embankments, *Flow measurement, *Subcritical flow, *Stage-discharge relations, Weirs, Water measurement, Channels, Backwater, Mathematical studies, Model studies, Flow profiles, Floods, Highway effects.
Identifiers: *Submerged flow.

A method is presented for determining the discharge of water over a highway embankment under submerged flow conditions, in which a change in tailwater depth affects upstream depth. The data required are upstream and downstream flow depth and the dimensions of the embankment. The method is illustrated using data collected from model highway embankments. A highway embankment, when overtopped by flood waters, is a form of broad-crested weir, and for freeflow conditions, discharge is a function only of upstream depth. If a downstream structure or other obstruction controls the stage-discharge relation, the depth of flow at the embankment may be sufficient to prevent critical flow on the roadway, and subcritical or submerged flow will occur. (Knapp-USGS)
W68-01022

GROWTH OF SPECTRAL COMPONENTS IN A WIND-GENERATED WAVE TRAIN,
Stanford Univ., Stanford, Calif. Dept. of Civil Engineering.
Alex J. Sutherland.
J Fluid Mech, vol 33, pt 3, pp 545-560, Sept 2, 1968. 16 p, 7 fig, 3 tab, 13 ref.

Descriptors: *Waves (Water), *Wind tides.
Identifiers: *Spectral growth, *Wind-generated wave, Energy transfer, Reynolds stress theory, Water surface displacement, Wave frequency.

In a laboratory investigation of the response of a water surface under the action of wind, power spectral density measurements were made of the water surface displacement in a wind-generated wave train. Growth rates of different components were determined from the measured spectra; the resulting values were compared with those predicted by the viscous Reynolds stress mechanism of energy transfer from wind to wave. The theory assumed the air-velocity profile to be linear near the water surface and to be asymptotically logarithmic. Where the growth was exponential, the theory could be made to predict growth rates successfully at wave frequencies less than 3 to 5 c/s. At higher frequencies the theory predicted values an order of magnitude larger than those measured. Limited regions of linear growth were found at the lowest wind speeds for components with frequencies less than 2 to 5 c/s. The viscous Reynolds stress theory is considered inadequate for predicting growth rates in situations where a spectrum of waves is involved. (Llaverias-USGS)
W68-01030

ONSET OF THERMOHALINE CONVECTION IN A POROUS MEDIUM,
Aukland University, New Zealand.
D. A. Nield.
Water Resources Res, Vol 4, No 3, pp 553-560, June 1968. 8 p, 1 tab, 19 ref.

Descriptors: *Porous media, *Convection, Geothermal studies, Mathematical studies, Thermodynamic behavior, Boundaries (Surface).
Identifiers: *Thermohaline convection, Perturbation analysis, Boussinesq approximation, Convective flow.

Linear perturbation analysis is used for the problem of the onset of convection, induced by buoyancy effects resulting from vertical thermal and solute concentration gradients, in a horizontal layer of a saturated porous medium. When a strongly stabilizing solute gradient is opposed by a destabilizing thermal gradient, with attention concentrated mainly on monotonic instability, oscillatory instability may be possible. For a general set of boundary conditions, the eigenvalue equation, involving a thermal Rayleigh number R and an analogous solute Rayleigh number S, is obtained by a Fourier series method. By extending existing results for the thermal problem, numerical solutions are found for some special limiting cases. When the thermal and solute boundary conditions are formally identical, the net destabilizing effect is expressed by the sum of Rayleigh numbers R and S. (Llaverias-USGS)
W68-01038

ON WAKES IN STRATIFIED FLUIDS,
Johns Hopkins University, Baltimore, Department of Mechanics.
G. S. Janowitz.
J Fluid Mech, Vol 33, Pt 3, pp 417-432, Sept 2, 1968. 16 p, 8 fig, 20 ref.

Descriptors: *Viscous flow, *Flow around objects, Stratified flow, Viscosity.
Identifiers: *Two-dimensional body, Non-diffusive viscous fluid, Problem solving, Fluid jets.

Consideration is given to a 2-dimensional body moving horizontally, with constant speed U, through an unbounded, linearly stratified, non-diffusive viscous fluid. The governing equations are linearized using the Oseen and Bossinesq approximations, and the boundary conditions at the body are replaced by a linearized momentum-integral equation. The solution of this linear problem shows a system of alternating jets upstream, which decay algebraically and become wider in the upstream direction, and a pattern of waves downstream of the body. The effects of viscosity on these lee waves are considered in detail. The asymptotic solution given is valid far upstream of the body. For low speeds, this solution becomes valid close to the body. Figures illustrate flow downstream of the body and show that, as the speed of the body increases, the lee waves increase in wavelength and attenuate more slowly. (Llaverias-USGS)
W68-01040

ANALYSIS OF SUBMERGENCE IN FLOW MEASURING FLUMES,
Utah State Univ, Water Research Lab, Logan.
Gaylord V. Skogerboe, and M. Leon Hyatt.
ASCE Proc, J Hydraul Div, Vol 93, No HY4, Pap 5348, pp 183-200, July 1967. 18 p, 15 fig, 12 ref.

Descriptors: *Open channel flow, *Hydraulics, *Flow measurement, *Subcritical flow, *Stage-discharge relations, Venturi meters, Venturi flumes, Flumes, Channels, Backwater, Mathematical studies, Flow profiles, Model studies.
Identifiers: Parshall flumes, Flat-bottom flumes, Submerged flow.

Calibration curves which describe submergence, the condition in which a change in tailwater depth affects upstream depth in flow-measuring flumes, are developed by a combination of dimensional analysis and empiricism. Parameters developed in this manner are further verified by the theoretical submerged flow equation developed from momentum relationships. A flat-bottomed rectangular measuring flume was used to generate data necessary for establishing the parameters describing submerged flow. The resulting form of the discharge equation has been verified for a trapezoidal flat-bottomed flume and a Parshall flume. For any particular flume geometry, the free flow and submerged flow equations have a common exponent and can be placed on a single calibration graph, which then gives the transition point from free to submerged flow. (Knapp-USGS)
W68-01123

DISPERSION OF MASS IN OPEN-CHANNEL FLOW,
Colorado State Univ., Fort Collins.
William W. Sayre.
Colo State Univ Hydrol Pap No 3, 73 p, Feb 1968. 48 fig, 7 tab, 1 append, 47 ref.

Descriptors: *Open channel flow, *Hydraulics, *Diffusion, *Dispersion, *Sediment transport, Turbulent flow, Turbulence, Mathematical models, Digital computers, Model studies, Hydraulic models, Flumes.
Identifiers: Shear flow.

The dispersion process for settling particles in a 2-dimensional turbulent shear flow is formulated in 2 differential equations, one for particles suspended in the flow and the other for those deposited on the bed. Exchange of particles between the bed and the flow is permitted. Using the Aris moment transformations, the equations are converted to a more tractable system of equations which are solved by numerical methods with the aid of a digital computer, for the zero, first, second and third moments of the longitudinal concentration distributions. Various combinations of boundary and other input conditions are imposed, and their effects on the dispersion process are demonstrated. The results of the numerical solutions together with the results of the earlier dispersion experiments with silt particles and fluorescent dyes show that the tendency of the silt particles toward deposition and temporary storage on the bed can profoundly affect the longitudinal dispersion process. Computer programs used in the study are included in an appendix. (Knapp-USGS)
W68-01129

ENERGY ABSORPTION IN HIGH-VELOCITY CURRENTS,
Enzo Levi, and Guillermo Gonzalez Escamilla.
Int Ass Hydraul Res, Proc 7th, Lisbon, Pap D-10, 9 p, 1957. (Transl from Span, Bur Reclam Transl 744, July 1968.) 10 p, 18 fig.

Descriptors: *Hydraulic models, Hydraulic structures, Hydraulic jumps, Hydraulic engineering, *Energy absorption, *Energy dissipation, Tunnels, Spillways, Outlet works, Outlets, *Model tests, Foreign design practices, Stilling basins.
Identifiers: Mexico, Solis Dam, Mexico, Miguel Hidalgo Dam, Mexico, Alvaro Obregon Dam, Mexico, El Sordo Dam, Mexico, *Energy dissipators.

Hydraulic model tests were conducted on energy dissipators for hydraulic structures having flows of 20 m/sec. Four different devices were tested; 3 were placed at the exit of deep intakes and 1 at the end of a spillway discharge flume. Model tests were conducted for designing the outlet works for Solis, Miguel Hidalgo, and Alvaro Obregon Dams, and the spillway for El Sordo Dam. Results of the model tests are summarized. Energy absorption devices for Solis and Alvaro Obregon Dams offer viable solutions if closing the discharge channel transversally is feasible. Energy dissipators for Miguel Hidalgo and El Sordo Dams are less efficient and more difficult to operate, but have the advantage of providing free passage to floating material. These dissipators permit good stilling of free high-velocity currents with more advantages than those offered by classical stilling tanks. Drawings and photographs of the models are shown. (USBR)
W68-01221

DESIGNING THE APPROACH CHANNEL FOR SHAFT SPILLWAYS,
A. R. Skue.
Trudy LPI, No 274, pp 38-46, 1966. (Transl from Russ, Bur Reclam Transl 734), Nov 1967. 19 p, 5 fig, 2 ref.

Descriptors: Foreign design practices, Hydraulics, Hydraulic models, Hydraulic engineering, *Model tests, Calculations, *Spillways, Piers, Hydraulic structures, Discharge coefficients, Pulsating flow, Spillway crests, Vortices, Excavation, Volume, Flow control, Design criteria, *Channels.
Identifiers: USSR, *Approach channels, *Morning glory spillway, *Shaft spillways.

The Vedeneev Hydraulics Institute in the USSR conducted model tests to perfect the design of approach channels to morning-glory spillways with restrictions imposed by the proximity of earth dam slopes or rock outcroppings. A parabolic channel shape with an obstructing pier and dividing piers to alleviate vortex formation was recommended. The proposed design is compared with results of previous work by a sample problem. Experiences encountered during laboratory model studies are described. (USBR)
W68-01226

INFLUENCE OF A METHOD OF AIR ADMISSION ON PRESSURE SURGES IN DRAFT TUBE MODELS OF AXIAL HYDRO-TURBINES,
Iu M. Isaev.
Gidromash Trudy LPI, No 215, pp 58-68, Moscow and Leningrad, 1961. (Transl from Russ, Bur Reclam Transl 756, July 1968.) 29 p, 7 fig, 6 ref.

Descriptors: Foreign design practices, Hydraulics, Model tests, Draft tubes, Hydraulic models, *Axial flow turbines, *Hydraulic turbines, Hydraulic transients, *Kaplan turbines, Turbines, Surges, Unsteady flow, Vortices, Water pressures, Instrumentation, Pressure sensors, *Aeration, Statistical analysis, Vibrations, Efficiencies, Air demand.
Identifiers: USSR, Leningrad Metalworks, USSR, Leningrad Poly Inst, USSR, *Machine design, Foreign research, *Hydarulic design.

Hydraulic model tests of the effects of air admission on pressure surges in axial hydraulic turbines are described. The reduction or growth in surge amplitude and the change in unit efficiency were investigated for several locations of air admission and varying quantities of air. The particular study described was for a Kaplan turbine. The most effective method was introduction of air through the flow-deflecting part of the cone. Surge amplitudes decreased approximately 45% and unit efficiency increased 0.5 to 1.0%. (USBR)
W68-01230

WAVE PROPAGATION AND BOUNDARY INSTABILITY IN ERODIBLE-BED CHANNELS,
Massachusetts Institute of Technology, Cambridge.
Mario H. Gradowczyk.
J Fluid Mech, Vol 33, Part 1, pp 93-112, July 1968. 20 p, 4 fig, 1 tab, 27 ref.

Descriptors: *Waves, *Bedloads, *Streambeds, Open channels, Boundary shear, *Scour, *Stream erosion, Open channel flow, Bibliographies, Froude number, Movable bed models, Boundary layer, Sediment transport, Hydraulics, Hydrology, Stream channels.
Identifiers: *Wave propagation, Bedload movement, Bed ripples, Great Britain, Shallow water, Bed roughness, *Erodible-bed channels.

Wave propagation in one-dimensional erodible-bed channels is discussed using a shallow-water approximation for the fluid and a continuity equation for the bed. In addition to gravity waves, a third wave is found that gives the velocity of propagation of a bed distrubance. An appropriate dimensional analysis yields the quasi-steady approximation for the

complete shallow-water equations. Linear stability analysis of free-surface flows is extended to include the erodibility of the bed. The critical Froude number above which the free-surface of the fluid may become unstable is obtained. Erodibility increases the stability of the free surface in qualitative agreement with previous experiments if the contact-bed discharge is greater than the the suspended-material discharge. The stability theory is used to discuss coupled beds and surface waves. Five different configurations have been obtained from the theory: a sinusoidal wave pattern moving downstream; a transition zone; and antidunes moving upstream, moving downstream, and remaining stationary. These bed forms agree with experimental results; the shallow-water theory gives a reasonable explanation of boundary instability. (USBR)
W68-01236

SOME STUDIES ON NEW TYPES OF FRICTION BLOCKS,
Indian Institute of Science, Bangalore, India.
N. S. Lakshmana Rao, and H. S. Suryanarayana Rao.
Irrig and Power (India), Vol 25, No 1, pp 29-40, Jan 1968. 12 p, 13 fig, 1 tab, 16 ref.

Descriptors: *Energy dissipation, *Stilling basins, *Roughness (Hydraulic), *Fluid friction, *Hydraulic design, Open channel flow.
Identifiers: India, Friction blocks (Hydraulic).

Experiments were performed on the effects on stilling basin performance of friction blocks with and without passages, and with passages of different diameters in a horizontal, rectangular flume. The flow in the flume was supercritical throughout. It was observed that at higher upstream Froude numbers, rectangular blocks with larger diameter passages were better than the ones with smaller diameter passages, which in turn were more effective than rectangular blocks without passages. Similarly, at higher upstream Froude numbers, wedges with convergent passages were found to be more effective than the ones with straight passages, which in turn dissipate more energy than the wedge without passages. (Knapp-USGS)
W68-01258

VARIATIONS OF THE HYDRAULIC ROUGHNESS OF ALLUVIAL CHANNELS,
U. S. Geological Survey, Tucson, Ariz.
Thomas Maddock, Jr.
Symp on River Morphol, Gen Assembly of Bern, Sept-Oct 1967, Paper, pp 187-199, 1967. 13 p, 5 fig, 2 tab, 13 ref.

Descriptors: *Channel flow, *Channel morphology, *Roughness (Hydraulic), *Alluvial channels, Regime, Shape, Slopes width, Velocity, Discharge (Water), Sediment load, Particle size.
Identifiers: Bed form, Deformed bed, Mobile-bed fluviology.

The literature of experimental study of stream hydraulic properties is reviewed and summarized. Roughness of alluvial channels is controlled by the deformed stream bed; the hydraulic variables of width, depth, velocity, slope, and sediment load are mutually determined. The relation among the variables is not unique but depends upon whether any constraint is placed on any dependent variable. The following rules are proposed: If the water and sediment discharge per unit width of channel are independent variables, and slope and depth are free to vary, then V varies as (qS) to the 1/2 power. If the slope and the water discharge per unit of width are independent variables, and load and depth are free to vary, then V varies as (qS) to the 4/10 power. If unit sediment discharge is constant, unit water discharge is an independent variable, and velocity depth and slope are free to vary, then the depth-slope products are approximately constant. If depth is constant, unit discharge is an independent variable, and load and slope are to vary, slope will be approximately constant. On a stream of fixed slope with a constant discharge, when sediment load varies, the adjustments are reflected in changes in both the friction factor and the average shear stress. (Knapp-USGS)
W68-01273

8C. Hydraulic Machinery

OPTIMAL POLICY FOR HYDROELECTRIC OPERATIONS,
Stanford Univ., Stanford, Calif.
John Gessford, and Samuel Karlin.
Studies in the Math Theo of Inventory and Production, Stanford Math Studies in the Social Sci, I, pp 179-200, 1958. 22 p, 9 fig, 7 ref.

Descriptors: Reservoir operation, *Hydroelectric power, Optimization, *Statistical models, Power marketing, Reservoir storage, Water policy.
Identifiers: Grand Coulee, Inventory theory, Cost functions.

Inventory theory techniques were used to structure and study two hydroelectric models. Random inflows with time varying probability distributions were considered. The objective was to minimize expected total cost incurred during some future interval, subject to energy demand and water availability. Total demand was assumed to be known. In the first model the cost function was assumed linear and a fraction of the electric energy was assumed to be supplied from other sources. The optimal policy was shown to be dependent on a single reservoir volume parameter, which could be calculated from the long-run expected cost. In the second model a convex cost function was assumed. The optimal policy was shown in that case to be also dependent on a single volume parameter. An example using data from Grand Coulee dam was solved using the first model.
W68-01150

TRANSIENT RECOVERY VOLTAGE CAUSED BY DIFFERENT SWITCHING OPERATIONS IN HV NETWORKS CONTAINING UNDERGROUND CABLES,
Brown, Boveri and Co, Ltd, Baden, Switzerland.
A. Eidinger, and G. Koppl.
Brown Boveri Rev, Vol 55, No 4/5, pp 175-181, Apr/May 1968. 7 p, 8 fig, 11 ref.

Descriptors: *Transmission lines, Extra high voltage, Surges, Electric potential, Inductance, *Electric cables, Capacitance, Costs, Electrical impedance, Dielectrics, Electrical networks, Circuit breakers, Faults (Electrical), *Transients.
Identifiers: Switching surges, *Underground cables, Foreign research, *Transient recovery voltage, Switzerland, *Switching, Network analysis.

Extensive use of high-voltage cable networks for voltages above 100 kv is infrequent because of economic reasons. Mixed networks of overhead transmission and underground cable are becoming more numerous in large cities and surrounding areas. This paper examines the effect of cable sections of varying lengths on the transient recovery voltage. The calculations made provided for cables no longer than 7 km (4.3 mi) since modern high-voltage networks contain only short cable sections. Various switching operations are examined in different network configurations. Results indicate that circuit breakers satisfying all requirements for switching of overhead lines will handle networks combining overhead lines and underground cables. (USBR)
W68-01211

STRESSES IN TRANSMISSION LINE CONDUCTORS NEAR THE SUSPENSION CLAMP,
Technical University of Munich, Germany.
W. Buckner, H. Kerner, and W. Philipps.
Pap 23-07, Int Conf Large High Tension Elec Syst, Paris, France, June 1968. 14 p, 9 fig, 7 tab, 3 ref.

Descriptors: *Transmission lines, Transmission (Electrical), Stress, Field tests, *Vibrations, Vibration suppressors, *Tensile stress, Test procedures, Experimental data, *Bending stress, Clamps, Test facilities, Frequency, Strain gages.
Identifiers: *Electric conductors, Test transmission lines, *Vibration tests, Suspension, Test results, Germany, Foreign research, Stress gages.

Wind-induced vibrations and the danger they present to high-voltage overhead conductors are of great importance to designers. This report discusses results of vibration tests performed on an energized experimental line in south-central Germany. Comparison measurements were made on ACSR conductors with various tensile stresses and conductor types. Investigations were made of influence of bundled conductors, vibration dampers, and special arrangements of the suspension point. In addition to vibration measurements, static bending stress at the suspension clamp was measured. Conductor vibrations were considered the main problem at the beginning of the tests. However, measurements indicated that dynamic and static bending stresses at the suspension clamp should be considered with tensile stress, and that static bending stress at the suspension clamp is an important factor previously ignored. These tests have been made possible by a new dynamic testing device, attached to the conductor, that transmits signals to a tape recorder at the base of the tower. Data are evaluated automatically by a computer. (USBR)
W68-01213

1100-KV STATION AND LINE INSULATION DESIGN,
Westinghouse Electric Corp., East Pittsburgh, Pa.
A. R. Hileman, J. P. McKinnon, and J. K. Dillard.
Pap 25-06, Int Conf Large High Tension Elec Syst, Paris, France, June 1968. 10 p, 10 fig, 14 ref.

Descriptors: *Extra high voltage, Test facilities, Test procedures, *Electric insulation, Contamination, Research and development, *Electric cables, *Impulse tests (Electrical), Transmission (Electrical), Design, Lightning, Economics, Substations (Electrical).
Identifiers: *Switching surges, Lightning arresters, *Underground cables, Electrical insulators, Electrical design, Test results.

Design of a facility for testing underground cable systems rated 121 to 765 kv required switching surge and impulse tests on insulator arrangements at test voltages of 635-kv single-phase (equivalent to 1100-kv phase-to-phase) necessary for testing 765-kv cable samples to 150% over-voltage. The test procedure is described and results are given. Switching surge tests provided data to assess the design of 1100-kv systems. Comparison of the lightning, contamination, and switching surge requirements shows that designing and 1100-kv transmission line to withstand greater than 1.8-per unit (pu) switching surges appears technically infeasible with present available knowledge and materials. Switching surge withstand design levels of 1.6 pu are feasible. Meeting estimated contamination requirements is possible, but the design may be uneconomical in regions of high pollution. Estimates of insulation requirements in 1100-kv stations show that designing switching surge levels greater than 1.6 pu is technically infeasible, using present design philosophy. Contamination requirements may be a greater problem for stations than for transmission lines. More research is needed on the breakdown mechanism of large-spaced gaps, methods of reducing surges, and contamination. (USBR)
W68-01214

EXPERIENCE WITH TRANSISTORISED PROTECTION IN BRITAIN,
A Reyrolle and Co Ltd and CEGB, Great Britain.
F. L. Hamilton, J. B. Patrickson, and F. H. Birch.
Pap 31-04, Int Conf Large High Tension Elec Syst, Paris, France, June 1968. 16 p, 11 fig, 3 tab, 7 ref.

Descriptors: *Transistors, *Electric relays, Investigations, Circuits, Transients, Reliability, Electric power, Semiconductors, Silicon, Extra high voltage, Electrical equipment, *Electronic equipment, Power system operations, Germanium, Electrical stability, Temperature, Laboratory tests, Electrical grounding, Design.
Identifiers: *Protection (Electrical), Application techniques, Great Britain, Foreign research, Overvoltage, Performance.

Transistorized protection in Britain is modeled on characteristics and arrangements of established forms of electro-mechanical protection. Increased performance is achieved, but the potential of transistorized relays and protection has not been exploited. Present developments must be considered as a transitional stage leading toward new concepts of protection, new physical arrangements, and greater coordination with other control functions. Many aspects of present experiences are considered important to future developments; these are discussed in relation to development, production, and application over a wide range of equipment. Environmental conditions influencing the design of transistorized equipment have been an important consideration; one of the most important is overvoltages occurring on secondary circuits and relay equipment. Investigations and measurements made at ehv stations in Great Britain to determine the magnitude and nature of such overvoltages are reported. An interim specification has been developed for testing transistorized equipment to ensure its ability to withstand these conditions. (USBR)
W68-01215

HIGH SPEED PROTECTION OF POWER SYSTEMS BASED ON IMPROVED POWER SYSTEM MODELS,
G. R. Slemon, S. D. T. Robertson, and M. Ramamoorty.
Pap 31-09, Int Conf Large High Tension Elec Syst, Paris, France, June 1968. 15 p, 10 fig, 7 tab, 16 ref, append.

Descriptors: *Electric relays, Faults (Electrical), Analysis, Models, Bibliographies, Digital computers, Transmission (Electrical), Electric potential, Errors, *Power system operations, Electrical stability, Electric currents, Electric power, Transients, Electrical impedance, Circuits, Transmission lines, Simulation.
Identifiers: *Protection (Electrical), Synchronous machines, Wave shape, Reactance, Performance, Short circuits, Ground currents.

Protection systems use information derived from voltage and current waveforms to diagnose fault conditions and initiate appropriate switching operations. Designing and testing protection systems require knowledge of the voltage and current signals following any type and location of fault. Design information normally is obtained from models of the power system. Use has been made of pseudosteady-state models representing synchronous machines by appropriate voltage and reactance; each line is represented by an impedance or an equivalent parallel or branched circuit. Models with refinements to include machine transients have proved adequate for designing slow-speed, electromechanical relay systems. Modern high-speed static relays often operate on information derived during the first- or second-half cycle following a disturbance. More sophisticated models of machines and lines are required to predict transient information. Several models suitable for simulation on a digital computer are discussed. Errors arising from use of traditional models are evaluated. New relaying functions are proposed, suggested by studies made on post-fault signals obtained from more precise models. (USBR)
W68-01216

A TECHNICAL AND ECONOMIC COMPARISON BETWEEN AC AND DC TRANSMISSION,
W. Casson.
Pap 42/43-01, Int Conf Large High Tension Elec Syst, Paris, France, June 1968. 20 p, 12 fig, 5 tab, 2 append.

Descriptors: Extra high voltage, Extra long distance, Costs, Circuits, *Alternating currents, *Direct currents, Electric insulation, Electrical equipment, *Transmission (Electrical), Converters (Electrical), Electric cables, Electric power, Economics, *Cost comparisons.
Identifiers: *Interconnected systems, Economic evaluation, Interties, Submarine cables, Underground cables, Foreign research, Great Britain.

A CIGRE Committee studied the economics, security, and characteristics of equivalent long-distance overhead line and cable links. The studies are identical for different countries, and based on 1965 costs. Present-day technology permits satisfactory construction of either a-c or d-c overhead transmission lines. D-c transmission has the advantages of controllability, no transfer of short-circuit power, and no need for series and shunt reactive compensation. However, dc has more complex and more expensive terminal equipment. Overhead d-c lines are cheaper than a-c lines of the same rating, but the cost of lines and terminal equipment reaches a breakeven point at 600 mi and dc becomes cheaper for longer distances. Underground cable for d-c transmission proves to be uneconomical for distances of less than 50 mi. Dc has a distince advantage over ac for transmission schemes involving long submarine cable crossings or for an asynchronous link between 2 systems with different characteristics. Analyses and appraisals included in this report are statements of present-day status of ac and dc and will change with the rapidly evolving technology in power transmission. (USBR)
W68-01217

STUDIES ON THE INTEGRATION OF A D-C TRANSMISSION LINE INTO AN A-C NETWORK,
Philadelphia Electric Co, Pa and American Electric Power Service Corp, New York, N Y.
J. J. Dougherty, and V. Caleca.
Pap 4303, Int Conf Large High Tension Elec Syst, Paris, France, June 1968. 12 p, 7 fig, 4 tab, 1 ref.

Descriptors: *Model tests, Laboratory tests, Power system operations, *Alternating currents, *Direct currents, Electric power, Disturbances, Test facilities, Converters (Electrical), *Electrical stability, Extra high voltage, Transmission (Electrical), Simulation, Transients, Faults (Electrical), *Electrical networks.
Identifiers: Overvoltage, Evaluation, *Model studies, *Test results, *Interconnected systems, Interties, Switching surges.

The Edison Electric Institute's 700-kw a-c/d-c system model laboratory is described. A series of studies performed on the model to evaluate the interactions between an a-c system and a d-c link are reported. The effect on a-c system stability of short transient disturbances in the d-c link was studied and results are given. A report is given of studies made on a low-power-level system simulator and on the 700-kw model to investigate overvoltages on a d-c line due to d-c line faults and converter disturbances. Overvoltages induced on one pole of the d-c line due to a fault on the opposite pole have been verified to not exceed 1.7 times the unit value. Certain double contingencies such as commutation failures coinciding with line faults may produce higher overvoltages. (USBR)
W68-01218

RESULTS IN HVDC CONVERTOR TESTING AND UTILIZATION OF THE RHEINAU RESEARCH LABORATORY FACILITIES,
Siemens A G and A E G-Telefunken, Berlin, Germany; Brown Boveri and Co Ltd, Baden, Switzerland.
M. Bosch, M. Danders, and P. Etter.
Pap 43-05, Int Conf Large High Tension Elec Syst, Paris, France, June 1968. 13 p, 11 fig, 8 ref.

Descriptors: *Test facilities, Theory, Simulation, *Direct currents, *Extra high voltage, *Converters (Electrical), Research and development, Experimental data, Design, Transmission (Electrical), Electric power, Electrical engineering, Electrodes, Investigations, Stress.
Identifiers: Foreign research, Germany, *Thyristors, *Test results, *Rheinau Res Lab, Germany, Magnetic amplifiers, Dielectric properties.

One Swiss and 2 German electrical manufacturing firms have pooled their resources to build a research laboratory at Rheinau near Heidelberg, Germany, for developing and testing high-voltage valves for hvdc installations. The facilities and capabilities of this ehv testing laboratory are described. Two research installations, a synthetic test circuit and a load test circuit, have been in operation since Nov 1966 and Sept 1967, respectively, and are suitable for longtime test runs. The test facilities have permitted a comprehensive investigation of ehv valves with a wide variation of stress parameters and with short-circuit stresses and inverter stresses as they occur in practical operation. Various mercury-arc valves have been tested, giving valuable indications of additional research needed. Tests are being conducted on thyristor stacks. (USBR)
W68-01219

UNIDIRECTIONAL REVERSE HONE SYSTEM PUMP TURBINE,
Miroslav Nechleba, and Vaclav Hosnedl.
Marianske Lazne CSSR, Hydro-Turbo Pap No C-2, 13 p, 1967. (Transl from Czech, Bur Reclam Transl 778), July 1968. 10 p, 6 fig, 3 ref.

Descriptors: *Pump turbines, Models, Model tests, Hydraulic turbines, Pumps, *Research and development, *Hydraulic machinery, Design, Losses, *Turbine runners, Efficiencies, Mechanical engineering, Laboratory tests, Bearings, Rotation, Moments of inertia, Turbine parts.
Identifiers: Foreign research, Czechoslovakia, Machine design, *Hone turbine, Innovation.

A new pump-turbine system was developed and tested in Czechoslovakia. The Hone system pump-turbine operates as a pump or as a turbine at the same rpm and in the same direction of rotation. The machine has a hemispherical exhaust chamber attached to the flange of the main shaft. This chamber houses 2 runners that can be revolved about an axis perpendicular to the main shaft. One runner remains hidden in the exhaust chamber and the other is opposite a divider with blades that can be adjusted for pump or turbine operation. The pair of runners reverses the circulation of the water and permits the main shaft to turn in the same direction of rotation. Advantages of this type of pump-turbine are: (1) dewatering the runner not in operation is unnecessary and this runner produces no ventilation losses; (2) very short changeover time is permitted for pumping or turbine operation; (3) the Hone pump-turbine has small-diameter high-speed runners; and (4) use of different runners gives longer machine life and both runners work within the optimum area of efficiency. (USBR)
W68-01225

HYDRAULIC TURBINE CONSTRUCTION IN THE USSR,
N. N. Kovalev.
Marianske Lazne CSSR, Hydro-Turbo Pap No C-18, 17p, 1967. (Transl from Russ, Bur Reclam Transl 763), July 1968. 12 p, 6 fig.

Descriptors: *Hydraulic turbines, *Hydraulic machinery, Turbine parts, Turbine runners, Research and development, Francis turbines, Cavitation, Analysis, Pelton turbines, Efficiencies, Laboratory tests, Model tests, Losses, Calculations, Computers, Viscous flow, Spiral cases, History, Hydroelectric power, Manufacturing, Design, Kaplan turbines.
Identifiers: USSR, Foreign research, Machine design, Hydraulic design, Leningrad Metalworks, USSR.

Hydraulic turbine manufacturing in the USSR for the past 10 yr is reviewed. Design improvements in weight, costs, efficiencies, specific speeds, cavitation characteristics, and capacity are discussed. Much work has been done on (1) 3-dimensional flow of a viscous fluid and determination of hydraulic losses in turbines; (2) development of methods for recalculating model-testing data into prototype conditions, such as the problem of the scaling factor; and (3) investigations of the effect of geometrical characteristics of rotors on the power and cavitation properties of turbines. Additional scientific research development work is needed for building turbines, with particular emphasis on the efficiency and reliability of water passages. The statics and dynamics of machine parts and elements are as important as process technology in producing parts for large turbines. (USBR)
W68-01229

8D. Soil Mechanics

FILTRATION RATES OF GROUND WATERS,
All Union Scientific Research Institute of Oil and Geology and Exploration, Moscow.
For primary bibliographic entry see Field 02G.
For abstract, see .
W68-01136

DISPERSION IN LAYERED POROUS MEDIA,
Dept. of Civil Engineering, Massachusetts Institute of Technology, Cambridge, Massachusetts.
Uri Y. Shamir, and Donald R. F. Harleman.
J Amer Soc of Civil Engineers, Hydraulics Div, Vol 93, No HY5, pp 237-269, Sept 1967. 24 p, 11 fig, 3 tab, 1 append.

Descriptors: *Dispersion, *Porous media, Seepage, Artificial recharge, Aquifers, *Analytical techniques, *Flow, Equations.
Identifiers: Layers.

Practical problems involving dispersion in porous media arise in connection with seepage from rivers and canals, artificial recharge and sea water intrusion into coastal aquifers. The study treats two problems of dispersion in layered media: each layer is of uniform thickness and is considered homogeneous and isotropic; if the layers are thin, and alternating layers are made of the same material, the formation approximates an anisotropic medium with perpendicular major and minor axes. Analytic solution for the problems are developed and verified experimentally. The theory of dispersion in porous media is explained using 68 equations, in combination with the longitudinal dispersion in flow perpendicular to layers and the lateral dispersion in flow along the layers. Equipment was developed to measure the longitudinal and lateral dispersion in homogeneous and layered media. (Blecker-Ariz.)
W68-01178

CRIB DAMS FOR CONTROL OF SEDIMENT AND STREAMBED EROSION AND THEIR SUITABILITY FOR CONDITIONS IN PAKISTAN,
Pakistan Forest Institute, Peshawar.
Anwar Masrur.
Pakistan J of Forestry, Vol 16, No 2, pp 128-137, April 1966. 10 p, 7 fig.

Descriptors: *Rockfill dams, *Sediment control, Stream erosion, Streambeds, *Alluvial channels, Bank erosion, Streams, *Dam design.
Identifiers: Crib dams.

Crib dams serve to reduce streambed erosion through stabilization of channels and side slopes and at the same time control sediment movement in streams. Best results are achieved by the proper planning of a system of these dams in such a way that each structure supports the next one upstream. The nine advantages that crib dams have over other types of dams are given. The selection of suitable sites for the structures is most important so as to achieve the desired stabilization at minimum expense. The size of the dam and the design depends mostly on the drainage area and on the discharge to be expected according to previous records of amount and intensity of the rainfall. Figures and photographs are used to explain the construction details of the dams. (Blecker-Ariz.)
W68-01179

THEORETICAL STUDIES OF CRATERING MECHANISMS AFFECTING THE STABILITY OF CRATERED SLOPES,
Duke University, Durham, N C.
Aleksandar S. Vesic, Gordon P. Boutwell, Jr., and Tein-Lie Tai.
Duke Univ, Sch Eng Soil Mech Ser No 11, Mar 1967. 129 p, 72 fig, 11 tab, 27 ref.

Descriptors: Bibliographies, *Cratering, *Craters, *Explosions, Sands, Nuclear explosions, Slopes, Submergence, Saturation, Piezometers, *Pore water pressures, Pore pressures, Model tests, Soil tests, Cavities, Test procedures, Laboratory tests, Soil mechanics, Shock waves, Excavation.
Identifiers: Slope stability, Soil pore structure, Stability.

Cratering phenomena are studied in situations where: (1) the cratered medium is below the water table, (2) the surface of the cratered medium is sloped, and (3) several charges are detonated simultaneously. Pore-fluid stress waves caused by an explosion in a submerged media seem to be coupled with corresponding skeleton waves; their shapes suggest that they may be composites of several waves. Peak positive stress of fluid waves in sand appears to be proportional to energy yield of the charge, and it decays inversely with the cube of distance from the explosive charge. Peak negative stress may become larger than peak positive stress. Residual pore-fluid stresses will occur only if the density of the material is altered. The initial sequence of cratering phenomena is identical with that observed in an analogous case with a horizontal surface when an explosive charge is detonated close to the inclined surface of a homogeneous, isotropic medium. Tests with multiple-row charges show a sequence of events bearing some similarity to cratering phenomena observed with single charges. (USBR)
W68-01195

LONG-TERM DEFORMATION IN CLAY,
Ohio State University, Columbus.
T. H. Wu.
Transp Res Center Rep No EES 290-1, Dec 1967. 18 p, 9 fig, 1 tab, 5 ref.

Descriptors: *Deformation, *Creep, Consolidation, *Clays, Settlement, Stress, Stress distribution, Pore pressures, *Embankments, Saturation, *Triaxial shear, Triaxial tension, Triaxial stress, Strain, Pore water pressures, Hydrostatic pressures, Soil mechanics, Soils.
Identifiers: Strain rate, Deviator stress.

Deformation of an embankment due to creep is as great as that due to consolidation. Major and minor principal stresses are in vertical and horizontal directions during embankment construction. After completion of the embankment the soil element is subjected to change in the principal stresses plus a rotation of the principal axis. Compression and extension triaxial undrained creep tests were performed on saturated, remolded Grundite clay. Specimens were consolidated under stresses of 1.25, 2.50, and 5.00 kg per sq cm. Deviator and lateral stresses were applied after consolidation with no drainage allowed, and the pore pressure was monitored continuously. Stress state has an important influence on creep rate; a consistent stress-strain-time relationship holds for the different stress states. Volume change effects should be considered since the magnitudes of creep and consolidation are similar. Numerical calculations were made for 2 stress conditions to obtain an estimate of deformation due to creep. Two embankments were assumed, one with narrow top and one wide embankment, each built in 10 layers over a period of 10 days. For a 30-ft embankment, settlement for 3 yr is 0.15-0.21 ft. (USBR)
W68-01198

THE EFFECT OF PLACEMENT METHOD ON THE RESPONSE OF SOIL STRESS GAGES,
Corps of Engineers, Vicksburg, Miss.
P. F. Hadala.
U S Army Eng Waterways Exp Sta Tech Rep No 3-803, Nov 1967. 75 p, 23 fig, 6 tab, 9 ref, append.

Descriptors: *Gages, *Instrumentation, Test procedures, Scattering, *Earth pressures, Epoxies, Sands, Clays, Soil pressures, Stress, Soil mechanics, *Pressure gages.
Identifiers: Soil dynamics, *Soil stress gages.

The placement method used in static tests with steel-epoxy soil stress gages has a definite influence on the mean overregistration ratio and scatter of data around the mean. The overregistration ratio may change as much as 40% due to placement method changes. Overregistration and underregistration of very stiff gages are possible, depending on the soil in which they are embedded and the way they are placed. Several placement methods were studied. The set-on-surface method was the best of the sand test placement methods, and the cut/no-cover method was the best of the clay placement methods. Tests made in clay exhibited lower registration ratios than those made in sand. Data scatter found in this study suggests that using a single soil stress gage to measure the magnitude of stress in a soil mass with any reasonable degree of confidence is fruitless. When measuring earth pressure magnitudes in virgin-loaded, compacted specimens similar to those used in this study, the average of 3 soil stress gage measurements should be used if 20% accuracy is required for a 90% confidence interval. (USBR)
W68-01202

RIGID PIPES IN SYMMETRICAL AND UNSYMMETRICAL TRENCHES,
Danish Geotechnical Institute, Copenhagen, Denmark.
N. H. Christensen.
Geotek Inst Bull No 24, 1967. 24 p, 22 fig, 1 tab, 22 ref.

Descriptors: Bibliographies, *Trenches, *Pipes, Lateral forces, *Earth pressures, Internal friction, Cohesion, Deformation, Model tests, Design criteria, Test procedures, Live loads, Load distribution, Shear forces, Bending moments, Soil mechanics, Backfills.
Identifiers: Foreign research, Failure surfaces, Spangler formula, Marston formula, Denmark.

The structural problem of rigid pipe in soil is treated with the classical Marston theory as a starting point. This method is not suited for unsymmetrical pipe trenches where one pipe is placed at the edge of a deeper excavation for another pipe. The complete projection condition of the classical theory should be treated by Kotter's equation. A series of model tests with unsymmetrical conditions is described, following an analysis of shear or friction forces in ruptures approximated by vertical sliding planes along trench walls and tangent to the pipe side. A complete theoretical explanation of the measured loads on the pipe cannot be found; the results are expressed in a set of semiempirical formulas. The investigation indicates that loads in shallow trenches may be greater than predicted by Marston's theory, and that the coefficient defining shear forces depends on the fill type and amount of sliding in failure planes. A design procedure is suggested. Structural characteristics of pipes and loading conditions are treated together with known approximate methods for considering live loads. Results of studies of 4 cases of pipe failures verify the validity of the new method. (USBR)
W68-01207

STABILITY OF DAMS ERECTED OF LOCAL MATERIALS UNDER DYNAMIC LOADS,
A. A. Nichiporovitch, and V. G. Melnik.
Res Inst VODGEO Pap, Transl from Russ, 1968. 19 p, 5 fig, 8 ref.

Descriptors: *Earth dams, Earthquakes, *Seismic design, Model tests, Seismic properties, Models, Deformation, *Earth movements, Settlement, Consolidation, Stress distribution, Stress, Soil mechanics, Live loads, Displacements, Simulation, Seismic investigations.
Identifiers: *Soil dynamics, Seismic stability, Seismic studies, USSR, Seismic tests, Earthquake engineering, Earthquake loads.

Seismic stability of high earth dams made from local materials was studied. Attention is given to experimental investigations of dam behavior during earthquakes without considering existing methods of analysis. Soils have a seismic consolidation limit of 2 to 4 kg per sq cm and no further consolidation is observed under seismic action. This indicates that the main deformations in dams are encountered in surface layers 10 to 15 m deep and are due to particle displacement along the slope. Modeling dams to estimate their seismic resistances is not recommended because the low stresses in the models are below the limits of seismic compaction. Deformations along the slope depend on acceleration, density, and size of materials fractions. The magnitude of particle displacements along the slope with an acceleration of 0.4 to 0.5 g did not exceed 20 mm after each seismic shock. Vertical deformations sharply attenuate in depth even within the limits of 3 m. (USBR)
W68-01208

THE USE OF SOIL MECHANICS METHODS FOR ADAPTING TOWER FOUNDATIONS TO SOIL CONDITIONS,
University of Grenoble, France.
J. Biarez, and Y. Barraud.
Pap 22-06, Int Conf Large High Tension Elec Syst, Paris, France, June 1968. 40 p, 29 fig, 17 tab, 13 ref, append.

Descriptors: *Transmission towers, *Foundations, Model tests, Theory, *Footings, Soil mechanics, Field tests, Penetration tests, Experimental data, Design, Soil physical properties, Vane shear tests, Shear planes, Transmission (Electrical), Investigations, Soil samplers, Towers, Shear strength, Stress distribution.
Identifiers: *Uplift footings, Uplift resistance, Foreign research, In situ tests, France.

Uplift of foundations determine the sizes of footings required for 4-legged towers of overhead transmission lines. The most commonly used method consists of calculating the uplift resistance of a foundation as that given by the weight of soil included in a truncated cone whose small area is equal to the base of the foundation and whose semi-angle at the top is assessed as a function of the assumed soil resistance. A method is discussed for applying soil mechanics principles to the design of uplift footings for towers. The study on laboratory models and results of full-scale field tests performed throughout different countries of the world was made at the University of Grenoble, France, under the auspices of a CIGRE Study Committee. The report gives results of this work and discusses: (1) a general study of the design method, (2) practical application with some examples, (3) a survey of in situ measurement methods of soil mechanical properties, and (4) the technique of foundation installation. Calculations and test results are compared. (USBR)
W68-01212

SAND DISPERSION IN A LABORATORY FLUME,
Colorado State Univ., Department of Civil Engineering, Fort Collins.
For primary bibliographic entry see Field 02J.
For abstract, see .
W68-01247

8E. Rock Mechanics AND Geology

THE TASHKENT EARTHQUAKE,
Uzbekistan Institute of Seismology; Tashkent Central Seismic Station, USSR.
G. Mavlyanov, and V. Ulomov.
Sci J, Vol 4, No 6, pp 75-80, June 1968. 6 p, 4 fig, 4 photo, 2 ref.

Descriptors: Shock waves, Foreign design practices, Buildings, Seismic waves, *Seismic design, Seismology, Structural engineering, Structures, Structural behavior, Engineering geology, Faults (Geology), Vibrations, *Earthquakes, Damages, Disasters.
Identifiers: *Tashkent Earthquake 1966, *Earthquake damage, Earthquake engineering, *Earthquake-resistant struct, Epicenters, USSR.

In the spring of 1965 long fissures appeared in the ground in the Kyzyl-Kum Desert northwest of Tashkent, the capitol of the Republic of Uzbekistan. The fissures were related to seismic activity in the area. After studying the growth of the fissures and seismic activity in the area, seismologists predicted a strong earthquake. On April 26, 1966, an earthquake of intensity force 8 and magnitude 5.3 hit the center of Tashkent, followed by 1000 aftershocks over the next year. The earthquake provided a test for earthquake resistance of buildings and showed differences in seismic phenomena between the epicentral zone and at a distance. Shocks in the epicentral zone are characterized by high-frequency vibrations, greater-size vertical components, and nearly total absence of surface waves. Damages to modern earthquake-resistant buildings and older structures are discussed. Experiences show that framed, large-paneled buildings with flexible ground floors supported on columns withstood the earthquake best. The Tashkent studies show that earthquake design in the epicentral zone should consider vertical and horizontal components of possible earthquakes.
W68-01205

DIFFERENCES BETWEEN EUROPEAN AND AMERICAN PRACTICE IN THE USE OF GROUT CURTAINS IN ROCK FOUNDATIONS,
P. Londe.
Pap, Conf De 30 Minutes Faite A Berkeley, Mar 1968. 21 p, 10 fig.

Descriptors: *Grout curtains, *Grouting, Foundations, Water pressures, Percolation, Permeability, Fissures, Cavities, Economics, Safety, Field permeability tests, Cracks, *Seepage, Seepage losses, Cement, Concrete dams, Cement grouts, Penetration, Foreign construction, *Underseepage, Rock foundations, Earth dams, *Dam foundations.
Identifiers: *Grouting pressure, Grout take, Grout mixes, Stability, Water losses, Europe.

A grout curtain is a narrow, deep treatment of rock to prevent percolation of seeping water. Water percolating through a dam abutment has three effects: (1) water loss due to discharge of seeping water; (2) erosion of soft parts of the rock; and (3) pressure of seeping water, threatening the stability of the foundation or downstream slope. Performing water tests is the best way to investigate the permeability and groutability of rock in depth. The practical rule used for years in Europe proposed that rock with water absorption of one Lugeon unit did not require grouting. A Lugeon unit is a borehole absorbing one liter of water per minute per meter of hole under a differential head of ten bars. Water tests alone do not give adequate information on groutability. For years the rule of thumb has contended that grouting pressures in Europe are five times greater than in America. Cement grades used for grout are finer in the U S than in Europe. American and European practices are moving toward each other in abandoning arbitrary rules that are not adapted to actual geological conditions. A thorough investigation of the foundation rock should be made before any specification on grouting is issued and the grouting and drainage design is decided. (USBR)
W68-01210

FILL A LAKE, START AN EARTHQUAKE,
International Association of Seismology and Physics of the Earth's Interior, Strasbourg, France.
J. P. Rothe.
New Sci, Vol 39, No 605, pp 75-78, July 1968. 4 p, 7 fig.

Descriptors: *Earthquakes, Seismology, Engineering geology, Disasters, *Dams, *Reservoirs, Geophysics, Geologic investigations, Seismic waves, Faults (Geology), Damages, Foreign projects, Water storage, *Lakes, Dam foundations, Damsites.
Identifiers: Hoover Dam, Kremasta Dam, Greece, Koyna Dam, India, Monteynard Dam, France, Canelles Dam, Spain, Kariba Dam, Rhodesia.

Abundant evidence proves that artificial lakes can produce earthquakes. The latest example occured at Koyna, India, in 1967, where at least 200 deaths occurred. A classic example is at Boulder (Hoover) Dam; no tremors had been recorded in the 15 yr preceding construction, but thousands of small tremors were recorded after reservoir filling began in 1935. Examples are cited of earthquakes associated with filling reservoirs at Karib Dam, Rhodesia; Monteynard Dam, France; Canelles Dam, Spain; and Kremasta and Marathon Dams, Greece. Seismic activity becomes particularly evident when reservoir depths exceed 100 m; activity begins when reservoirs are partially full or reach maximum fill, and appears to subside in a few years. The exact mechanism for major artificial earthquakes is not clear, although the energy is derived from the mass of stored water. Tremors occur only under specific geologic conditions, and filling reservoirs does not always produce earthquakes. Careful geologic surveys of dam and reservoir areas should precede building a dam. (USBR)
W68-01220

APPLICATION OF SEISMIC EXPLORATION METHODS IN ENGINEERING-GEOLOGICAL INVESTIGATIONS,
V. I. Bibanov, V. B. Grabek, and N. D. Krasnikov.

Inzh Seismol, No 3-4, pp 38-44, 1966. (Transl from Russ, Bur Reclam Transl 779), July 1968. 11 p, 3 fig, 1 tab, 16 ref.

Descriptors: Geophysics, *Seismic investigations, Seismic waves, Drill holes, *Engineering geology, Explorations, Subsurface investigations, Logging, Longitudinal waves, Transverse waves, Elasticity modulus, Water table, Rocks, Soils, Groundwater geology, Geologic formations, Foreign construction, Faults (Geology), Bibliographies.
Identifiers: USSR, Seismic velocity, Seismic refraction, *Seismic prospecting, Seismic reflection.

Seismic exploration and drill hole logging experiences in the USSR are described for engineering geological studies of construction sites. Engineering geology investigations include: (1) determining depth and relief of basement rocks; (2) identifying and tracing faults, fracture zones, Karst segments, buried ravines, and river channels; (3) finding aquifer horizons and water table; (4) locating boundaries between different rock layers; and (5) determining dynamic elastic parameters of various components of the geologic section. Seismic exploration and logging methods can be used in reconnaissance and in detailed investigations of construction sites. An example is given of seismic investigations to determine depth of basement rock and seismic section and elastic properties of overlying sedimentary rocks. Methods used were seismic logging, refraction shooting, and velocity measurements of longitudinal and transverse waves. Application of seismic methods to engineering geology investigations is quite suitable, but has not gained due recognition. Extensive field usage will decrease construction site studies and reduce expensive exploratory drilling. (USBR)
W68-01223

GEODIMETER FAULT MOVEMENT INVESTIGATIONS IN CALIFORNIA,
California State Department of Water Resources, Sacramento.
Renner B. Hofmann, John H. Bennett, and Douglas B. Crice.
Dep Water Resour Bull No 116-6, State Calif, May 1968. 178 p, 63 fig, 9 tab, 62 ref, 2 append.

Descriptors: *Faults (Geology), Bibliographies, *Geodimeters, *Earth movements, Movements, *Earthquakes, Aqueducts, Engineering geology, Seismology, Seismic investigations, *Surveying, Survey stations, Creep, Surveying instruments, Measuring instruments, *First order surveys.
Identifiers: Earthquake forecasting, Earthquake zones, California aqueduct, California State Water Proj.

The California State Water Project crosses known active faults in many places and closely parallels the San Andreas fault for several hundred miles. A fault monitoring program was initiated in 1959 to provide quantitative information on the magnitude and extent of fault movement. A model 2A geodimeter, a precise electro-optical distance-measuring system, is used to measure lines 8 to 20 mi long in a 2000-mi network over the 450-mi length of the aqueduct. Movement along San Andreas fault reaches a maximum of 4.4 cm/yr south of Hollister, representing a 7-ft movement in 50 yr. Movements diminish southward and become almost unmeasurable near Los Angeles. The coastal side of the fault moves northward relative to the continental side. Movements across the San Andreas, Hayward, and Calaveras faults north of Hollister equal those on the San Andreas fault near Hollister. Creep distribution between these faults varies with time. Small movements were noted near San Bernardino and in the vicinity of the White Wolf fault, but the Garlock fault has remained quiet. Fault movement rates often change prior to small earthquakes, suggesting that effective earthquake warnings may be possible. (USBR)
W68-01224

8G. Materials

PERFORMANCE OF DUCTILE-IRON PIPE IN SOILS,
National Bureau of Standards, Washington, D. C.
Melvin Romanoff.
J Amer Water Works Ass, Vol 60, No 6, pp 645-655, June 1968. 11 p, 9 fig, 2 tab, 2 ref.

Descriptors: *Cast iron, Iron, *Pipes, Steel pipes, Materials testing, *Corrosion, Pitting, Performance tests, Environmental tests, Pipelines, Soils, Exposure, *Water pipes, Field tests.
Identifiers: *Gray cast iron, *Underground corrosion, Carbon steels, Buried pipes, Product evaluation, Weight loss, *Ductile cast iron.

Underground corrosion test data are given for ductile iron pipe specimens after 8 yr burial at 5 test sites. Previous test results for gray cast iron are reviewed. Weight loss results show that ductile-iron specimens have the same general corrosion rates as steel specimens at 3 sites and lower weight losses at 2 sites. Pit-depth-time curves show that ductile iron corrodes at the same rate as steel at 3 sites and at a higher rate at 2 sites. Although weight-loss and pit depth data show minute differences in corrosion rates of ductile iron and carbon steel, for all practical purposes the 2 materials are considered to act alike in the same environments. Earlier studies indicated that gray cast iron and carbon steel corrode at the same rate in similar soil environments. The conclusion made is that gray iron and ductile iron corrode at nearly the same rate in the same soil environments, and that corrosion patterns and nature of corrosion products are similar. (USBR)
W68-01194

MEASURING INTERNAL TEMPERATURES IN MASS CONCRETE,
ENEL, Milan, Italy.
Michele Fanelli
Water Power, Vol 20, No 3, 4, 5, 6, pp 115-118, 155-160, 182-184, 235-240, Mar, Apr, May, June 1968. 19 p, 27 fig, 2 tab, 2 ref.

Descriptors: *Mass concrete, *Gravity dams, Deflection, Thermocouples, *Concrete dams, Concrete structures, Instrumentation, Deformation, Arch dams, *Temperature sensors, *Thermal expansion, Thermal stress, Errors, Thermometers, Dam design, Temperature, Locations, Measurement.
Identifiers: Thermal gradients, Heat flow, Temperature distribution, Temperature rise, Temperature profiles.

Criteria are discussed for optimizing the layout of thermometers in thick concrete structures for the most direct determination of the effects of temperature changes on dam deformation. Unsteady temperature variations such as diurnal fluctuations are not of interest; seasonal variations are the important fluctuations in thermal deflections. The problem is determining the locations and least number of thermometers for a good survey of long-range thermal variations, limiting consideration of external thermal variations to a periodic wave. Errors in plotted temperature curves are discussed, and the conventional approximate instantaneous temperature from the broken line diagram is compared to the real value of the effective linearized temperature difference. The averages of the actual temperature curve have greater effect in arch dam deflection calculations, but the effective linearized thermal difference almost exclusively determines the thermal deflection for gravity dams. Serious errors may be incurred when a thermometer malfunctions. Two complete instrument installations on adjacent vertical sections are recommended rather than duplicating thermocouples. (USBR)
W68-01203

8H. Rapid Excavation

POTENTIAL APPLICATIONS OF NUCLEAR EXPLOSIVES IN DEVELOPMENT AND MANAGEMENT OF WATER RESOURCES--PRELIMINARY CANVASS OF THE GROUND-WATER ENVIRONMENT,
U. S. Geological Survey.
Arthur M. Piper.
U S Geol Surv Rep TE1-873, 173 p, 1968. 6 fig, 79 ref.

Descriptors: *Water resources development, *Nuclear explosions, *Nuclear engineering, Water resources, Underground, Water storage, Water yield, Infiltration.
Identifiers: *Nuclear explosion chimneys, Permeability enhancement.

A survey was made of the feasibility of using nuclear detonations to change local hydrologic environments in order to increase porosity and permeability and create cavities for withdrawal or storage of larger quantities of fluids than would otherwise be possible. Most of the information was obtained from literature searches and personal conferences with water-resources researchers. No field work was done. Nuclear detonation may prove to be practicable only in unusual circumstances because of stringent environmental, economic, and legal limitations. Present studies of underground detonation in other fields than water resources should yield more definitive information. Work oriented specifically toward learning the hydrologic effects of detonations is suggested. (Knapp-USGS)
W68-01142

BIG-HOLE DRILLING IS COMING OF AGE UNDERGROUND,
G W Murphy Industries, Houston, Tex.
N. E. Norman.
Mining Eng, Vol 20, No 6, pp 41-46, June 1968. 6 p. 7 photo, 1 tab.
Descriptors: Mechanization, *Mining, Mining engineering, Construction, *Tunnel construction, Tunneling, *Tunneling machines, *Shafts (Mining), Underground structures, *Boring machines, Drilling, Drilling equipment, Rotary drilling, Rock excavation, Rocks, Muck, Reamers.
Identifiers: *Raise boring, Rock properties, Underground openings.

Big hole drilling is becoming more attractive to the mining industry because of mechanical improvements, a willingness to accept new methods for lowering costs, and the need to mechanize for increasing production in face of a decreasing supply of qualified labor. Three main features of big hole drilling applicable to mining are reviewed--shaft drilling, tunneling, and raise boring. Numerous large-diameter shafts have been drilled since 1950 using rotary drilling techniques; a table is given showing large-diameter shafts drilled in 1967. The first tunneling machines were developed for soft rock, but 5 machine manufacturers have built or designed machines for medium-hard rock. Several foreign manufacturers market hard rock machines, but none have been used in the U S. Raise boring machines have had greater impact on the mining industry than shaft drilling and tunneling machines. Numerous raise boring machines have been built since 1962, and 20 are in service throughout the world. Operating characteristics, advantages, and disadvantages of shaft drilling, tunneling, and raise boring machines are summarized. (USBR)
W68-01196

NEW AUSTRIAN TUNNEL CONSTRUCTION METHOD,
L. V. Rabcewicz.
Der Bauingenieur, Vol 40, No 8, pp 289-301, 1965. Transl from Ger, Bur Reclam Transl 781, July 1968. 36 p, 29 fig, 33 ref.

Descriptors: Bibliographies, *Tunnels, *Tunnel construction, *Tunnel linings, *Tunneling, Lateral forces, Rock mechanics, Geology, Cracking, Arch, Geologic formations, Construction, Stress distribution, Plastic deformation, Shear forces, Bending moments, Ultimate loads, Gunite, Deformation, Foreign construction.
Identifiers: Arch action, Austria, Tunnel supports.

Approximately 260 km of tunnels and galleries with covers up to 1500 m have been built in Austria, using a new tunneling technique. A relatively weak auxiliary concrete vault is constructed simultaneously with the tunnel excavation. The tunnel floor is then constructed to the total thickness required for the completed tunnel. A load-bearing vault is constructed when deformation measurements of the auxiliary vault indicate that lateral pressure has dissipated or equilibrium has been reached. Thickness of reinforcing steel in the load-bearing vault is determined by measuring the deformation in the auxiliary vault. Theoretical considerations of the technique are discussed. Construction practices used in 2 tunnels are given to illustrate the technique. The 400-m Massenberg tunnel runs through graphite, slate, and shale with crushed quartz water-bearing veins. The materials are undulated, very soft in some sections, and contain a short section of lime. The upper part of the second tunnel is in layers of ground gypsum that have been completely leached; the lower part is in dolomite, marl stone, and sandstone. (USBR)
W68-01197

SUBJECT INDEX

ABUTMENTS
SCOUR AND FILL IN ALLUVIAL CHANNELS WITH PARTICULAR REFERENCE TO BRIDGE SITES,
W68-01139 08A

ACCESS ROUTES
COLBERG, INC V STATE RIPARIAN LANDOWNER'S RIGHT TO EMINENT DOMAIN RELIEF FOR STATE IMPAIRMENT OF ACCESS TO A NAVIGABLE WATERWAY,
W68-01314 06E

ACCIDENTS
LIABILITY RESULTING FROM ARTIFICIAL BODIES OF WATER.
W68-01338 06E

ACOUSTICS
ULTRASONIC METHOD OF FLOW MEASUREMENT,
W68-01240 07B

ADMINISTRATION
WATER IN WEST PAKISTAN,
W68-01054 06B

REGULATORY ASPECTS OF FEDERAL POLLUTION CONTROL,
W68-01302 05G

LAND USE IMPLICATIONS OF SURFACE WATER ALLOCATION, CH 1 AND 2,
W68-01308 06D

LAND USE IMPLICATIONS OF SURFACE WATER ALLOCATION, CH 3 AND 4,
W68-01309 06D

SOME PHYSICAL, TECHNOLOGICAL, AND ECONOMIC CHARACTERISTICS OF WATER AND WATER RESOURCES SYSTEMS IMPLICATIONS FOR ADMINISTRATION,
W68-01341 06B

STATUTES FOR ADMINISTERING WATER USE IN THE SOUTHEAST,
W68-01350 06E

MISSISSIPPI WATER-USE LAWS AND ADMINISTRATION,
W68-01351 06E

LEGAL BASIS FOR WATER POLLUTION CONTROL,
W68-01352 06E

WATER POLLUTION CONTROL IN NORTH CAROLINA,
W68-01353 06E

THE ADMINISTRATION OF WATER LAWS IN FLORIDA,
W68-01356 06C

WATER RESOURCES PLANNING IN THE SOUTHEASTERN UNITED STATES,
W68-01358 06E

WATER PURITY A STUDY IN LEGAL CONTROL OF NATURAL RESOURCES,
W68-01360 05G

W68-01361 06E

TRANSITION TO CENTRAL ADMINISTRATIVE CONTROL,
W68-01364 06E

DEVELOPMENT OF CENTRAL ADMINISTRATING CONTROL,
W68-01365 06E

OPERATION OF THE STATE CENTRAL ADMINISTRATIVE AGENCY,
W68-01366 06E

ADMINISTRATIVE AGENCIES
WATER RESOURCES RESEARCH PROGRAM.
W68-01306 06E

WASTE RECOVERY AND POLLUTION ABATEMENT,
W68-01322 05F

WATER QUALITY CONTROL ACT OF 1965.
W68-01359 05G

OPERATION OF THE STATE CENTRAL ADMINISTRATIVE AGENCY,
W68-01366 06E

HEARINGS ON S4 BEFORE A SPECIAL SUBCOMMITTEE ON AIR AND WATER POLLUTION OF THE COMMITTEE ON PUBLIC WORKS, UNITED STATES SENATE.
W68-01369 05G

W68-01370 05G

WATER RESOURCES RESEARCH PROGRAM.
W68-01371 06D

ADMINISTRATIVE DECISIONS
WATER SUPPLY SUGGESTED FEDERAL REGULATION,
W68-01317 03B

PRIVATE WATER RIGHTS IN FRANCE AND IN THE EASTERN UNITED STATES,
W68-01320 06E

ADSORPTION
ADSORPTION CATALYZED CHEMICAL HYDROLYSIS OF ATRAZINE,
W68-01246 03F

AERATION
MANIPULATION OF RESERVOIR WATER FOR IMPROVED QUALITY AND FISH POPULATION RESPONSE.
W68-01143 05C

INFLUENCE OF A METHOD OF AIR ADMISSION ON PRESSURE SURGES IN DRAFT TUBE MODELS OF AXIAL HYDRO-TURBINES,
W68-01230 08B

AEROBIC TREATMENT
HOW TO OPERATE 'PACKAGE' WASTEWATER TREATMENT PLANTS,
W68-01020 05D

AGRICULTURAL WATERSHEDS
HYDROLOGIC DATA FOR EXPERIMENTAL AGRICULTURAL WATERSHEDS IN THE UNITED STATES, 1962,
W68-01121 04D

ALABAMA
THE DEVELOPMENT OF RIPARIAN LAW IN ALABAMA,
W68-01401 06E

ALCOHOLS
EFFECT OF TALLOW ALCOHOL ADDED TO SOIL ON THE TENSION, FLOW, AND EVAPORATION OF SOIL WATER,
W68-01173 02G

RETARDATION OF EVAPORATION FROM OPEN WATER STORAGES,
W68-02256 03B

ALFALFA
A PRELIMINARY STUDY ON THE EFFECT OF ARTIFICIALLY CREATED LAYERS IN SANDY SOILS ON YIELD OF ALFALFA,
W68-01099 03F

ALKALI SOILS
RESEARCH ON ELECTRORECLAMATION OF SALINE-ALKALI SOILS,
W68-01108 02K

ALLIGATORWEED
CHEMICALS MAY CONTROL STUBBORN ALLIGATORWEED,
W68-01277 04A

THE EFFECT OF DICHLOBENIL AND DICAMBA ON NODAL TISSUES OF ALLIGATORWEED,
W68-01278 04A

EFFECTIVENESS OF HERBICIDAL COMBINATIONS ON ALLIGATORWEED GROWING IN FLOWING WATER,
W68-01280 04A

EFFECT OF MORPHACTINS ON BEAN AND ALLIGATORWEED,
W68-01284 04A

ALLUVIAL CHANNELS
SCOUR AND FILL IN ALLUVIAL CHANNELS WITH PARTICULAR REFERENCE TO BRIDGE SITES,
W68-01139 08A

CRIB DAMS FOR CONTROL OF SEDIMENT AND STREAMBED EROSION AND THEIR SUITABILITY FOR CONDITIONS IN PAKISTAN,
W68-01179 08D

VARIATIONS OF THE HYDRAULIC ROUGHNESS OF ALLUVIAL CHANNELS,
W68-01273 08B

ALTERNATING CURRENTS
A TECHNICAL AND ECONOMIC COMPARISON BETWEEN AC AND DC TRANSMISSION,
W68-01217 08C

STUDIES ON THE INTEGRATION OF A D-C TRANSMISSION LINE INTO AN A-C NETWORK,
W68-01218 08C

ALTERNATIVE COSTS
WATER RESOURCES ALLOCATION, EXTRAMARKET VALUES, AND MARKET CRITERIA A SUGGESTED APPROACH,
W68-01111 06B

ANAEROBIC DIGESTION
PILOT PLANT STUDIES ON THE ANAEROBIC TREATMENT OF TANNERY EFFLUENTS,
W68-01125 05D

ANALOG MODELS
ELECTRICAL-ANALOG ANALYSIS OF GROUND-WATER DEPLETION IN CENTRAL ARIZONA,
W68-01034 04B

ANALOGS
ELECTRONIC ANALOG MODELING AS AN AID IN WATER RESOURCE INVESTIGATIONS,
W68-01232 03B

ANALYSIS
EXAMPLES OF RECENT ADVANCES IN ANALYTICAL TECHNIQUES FOR EVALUATING AQUIFERS,
W68-01118 07A

ANALYTICAL TECHNIQUES
SELECTIVE ION ELECTRODE SYSTEM FOR FLUORIDE ANALYSIS,
W68-01116 07B

EXAMPLES OF RECENT ADVANCES IN ANALYTICAL TECHNIQUES FOR EVALUATING AQUIFERS,
W68-01118 07A

A COMMENT ON OPTIMIZATION METHODS FOR BRANCHING MULTISTAGE WATER RESOURCE SYSTEMS,
W68-01158 06A

BALAS ALGORITHM FOR ZONED UNIFORM TREATMENT,
W68-01161 05D

DISPERSION IN LAYERED POROUS MEDIA,
W68-01178 08D

APPALACHIAN MOUNTAIN REGION
GROUND-WATER RESOURCES OF THE APPALACHIAN REGION,
W68-01140 03B

APPROPRIABLE WATERS
(THE NEED FOR RECONSIDERATION OF THE NAVIGATION SERVITUDE),
W68-01299 06E

(THE FEDERAL PROPRIETARY POWER IN WATER RIGHTS).
W68-01300 06E

APPROPRIATION
(THE COMMERCE CLAUSE AND THE NAVIGATION POWER),
W68-01298 06E

(THE NEED FOR RECONSIDERATION OF THE NAVIGATION SERVITUDE),
W68-01299 06E

(THE FEDERAL PROPRIETARY POWER IN WATER RIGHTS).
W68-01300 06E

(THE NEED FOR A NATIONAL WATER POLICY),
W68-01301 06E

WATER MUSHROOMING POPULATIONS,
W68-01344 06D

APPROXIMATION METHOD
MATHEMATICAL MODELS THE MULTISTRUCTURE APPROACH TWO SEASONS, PREDICTABLE HYDROLOGY,
W68-01153 06A

AQUATIC PLANTS
THE EFFECT OF DICHLOBENIL AND DICAMBA ON NODAL TISSUES OF ALLIGATORWEED,
W68-01278 04A

AQUATIC WEED CONTROL
CHEMICALS MAY CONTROL STUBBORN ALLIGATORWEED,
W68-01277 04A

EFFECTIVENESS OF HERBICIDAL COMBINATIONS ON ALLIGATORWEED GROWING IN FLOWING WATER,
W68-01280 04A

AQUATIC WEEDS
THE CONTROL OF WATER WEEDS,
W68-01235 04A

AQUEOUS SOLUTIONS
DETERMINATION OF MOLYBDENUM IN FRESH WATERS - A COMPARISON OF METHODS,
W68-01046 02K

AQUIFER
FLOW OF GROUNDWATER IN RELATIVELY THICK LEAKY AQUIFERS,
W68-01186 02F

AQUIFER CHARACTERISTICS
IDENTIFICATION OF AQUIFER PARAMETERS BY DECOMPOSITION AND MULTILEVEL OPTIMIZATION,
W68-01047 02F

EXAMPLES OF RECENT ADVANCES IN ANALYTICAL TECHNIQUES FOR EVALUATING AQUIFERS,
W68-01118 07A

AQUIFERS
GROUND-WATER RESOURCES OF CHOWAN COUNTY, NORTH CAROLINA,
W68-01024 04B

GROUND-WATER RESOURCES OF UPTON COUNTY, TEXAS,
W68-01036 04B

NATURAL RECHARGE IN TUCSON BASIN,
W68-01080 04B

AVAILABILITY OF GROUND WATER IN THE OAKTON QUADRANGLE AND PART OF THE WOLF ISLAND QUADRANGLE IN JACKSON PURCHASE REGION, KENTUCKY,
W68-01117 04B

AVAILABILITY OF GROUND WATER IN THE HICKMAN QUADRANGLE, KENTUCKY-MISSOURI-TENNESSEE,
W68-01122 03B

AVAILABILITY OF GROUND WATER IN THE PARTS OF THE WICKLIFFE AND WICKLIFFE NW QUADRANGLES IN JACKSON PURCHASE REGION, KENTUCKY,
W68-01132 04B

AVAILABILITY OF GROUND WATER IN PARTS OF THE CAIRO AND BARLOW QUADRANGLES IN THE JACKSON PURCHASE REGION, KENTUCKY,
W68-01134 04B

MINERALS AND WATER, BUTLER COUNTY, ALABAMA.
W68-01137 03B

GEOLOGY AND GROUND-WATER RESOURCES OF THE LOWER BIGHORN VALLEY, MONTANA,
W68-01144 04B

SUMMARY OF THE GEOLOGY AND GROUND-WATER RESOURCES OF PITT COUNTY, NORTH CAROLINA,
W68-01147 04B

REFRACTION DETERMINATION OF WATER TABLE DEPTH AND ALLUVIUM THICKNESS,
W68-01209 02F

GEOLOGY AND GROUND WATER RESOURCES OF THE KALISPELL VALLEY, NORTHWESTERN MONTANA,
W68-01265 04B

ARCTIC
FLUVIAL PROCESSES IN THE HIGH ARCTIC,
W68-01029 02C

ARID CLIMATES
SPECIES TRIALS IN THE SEMI-ARID SOUTHWEST OF NEW SOUTH WALES PART II--NATIVE SHRUB TRIALS IN THE HAY DISTRICT,
W68-01075 03F

ARIZONA
GROUNDWATER CONDITIONS IN THE WATERMAN WASH AREA, MARICOPA AND PINAL COUNTIES, ARIZONA,
W68-01028 04B

ARTIFICIAL RECHARGE
ARTIFICIAL GROUNDWATER RECHARGE THROUGH WELLS,
W68-01084 04B

ARTIFICIAL WATERCOURSES
LIABILITY RESULTING FROM ARTIFICIAL BODIES OF WATER.
W68-01338 06E

ASPHALT
RAINFALL COLLECTION FOR DOMESTIC WATER SUPPLIES,
W68-01079 03F

AXIAL FLOW TURBINES
INFLUENCE OF A METHOD OF AIR ADMISSION ON PRESSURE SURGES IN DRAFT TUBE MODELS OF AXIAL HYDRO-TURBINES,
W68-01230 08B

BANK STABILIZATION
RED RIVER BELOW DENISON DAM, LOUISIANA, ARKANSAS, OKLAHOMA AND TEXAS.
W68-01032 06B

BARK
WATER QUALITY DEGRADATION BY WOOD BARK POLLUTANTS,
W68-01269 05C

BAYS
SEDIMENTATION IN ONSLOW BAY (IN GUIDEBOOK FOR FIELD EXCURSIONS, GEOLOGICAL SOCIETY OF AMERICA, SOUTHEASTERN SECTION),
W68-01262 02L

SUSPENDED SEDIMENT OF THE NORTHERN CHESAPEAKE BAY,
W68-01268 02L

BEACHES
TIDELANDS AND RIPARIAN RIGHTS IN FLORIDA,
W68-01376 06E

BED LOAD
STREAMFLOW FLUCTUATION, BAR ROUGHNESS, AND BED LOAD MOVEMENT A HYPOTHESIS,
W68-01044 02E

BEDLOADS
WAVE PROPAGATION AND BOUNDARY INSTABILITY IN ERODIBLE-BED CHANNELS,
W68-01236 08B

BEDS
PUBLIC RIGHTS IN WATER USES AND PRIVATE RIGHTS IN LAND ADJACENT TO WATER - DIVISION B PRIVATE RIGHTS IN LAND ADJACENT TO WATER,
W68-01289 06E

BENEFICIAL USE
PLANNING FOR WATER RESOURCE DEVELOPMENT.
W68-01185 06B

CLASSES OF WATER AND CHARACTER OF WATER RIGHTS AND USES - SECTION 54 BENEFICIAL AND REASONABLE USES OF WATER,
W68-01293 06E

BENEFIT SHARING
THE COLUMBIA RIVER TREATY,
W68-01064 06E

BENEFIT-COST RATIO
INCOME REDISTRIBUTION EFFECTS AND BENEFIT-COST ANALYSIS,
W68-01050 06C

BIOCHEMICAL OXYGEN DEMAND
A STUDY IN THE ECONOMICS OF WATER QUALITY MANAGEMENT,
W68-01051 05G

WATER QUALITY DEGRADATION BY WOOD BARK POLLUTANTS,
W68-01269 05C

BORING MACHINES
BIG-HOLE DRILLING IS COMING OF AGE UNDERGROUND,
W68-01196 08H

BOUNDARIES(PROPERTY)

PUBLIC RIGHTS IN WATER USES AND PRIVATE RIGHTS IN LAND ADJACENT TO WATER - DIVISION B PRIVATE RIGHTS IN LAND ADJACENT TO WATER,
W68-01289 06E

BOUNDARY PROBLEMS RAISED BY THE SUBMERGED LANDS ACT,
W68-01394 06E

BOUYOUCOS BLOCKS
A COMPARISON OF GYPSUM BLOCKS AND EVAPORIMETERS FOR IRRIGATION CONTROL,
W68-01104 03F

BRIDGES
SCOUR AND FILL IN ALLUVIAL CHANNELS WITH PARTICULAR REFERENCE TO BRIDGE SITES,
W68-01139 08A

BRUSH CONTROL
PLANNING FOR WATER RESOURCE DEVELOPMENT.
W68-01185 06B

CALIFORNIA
COLBERG, INC V STATE RIPARIAN LANDOWNER'S RIGHT TO EMINENT DOMAIN RELIEF FOR STATE IMPAIRMENT OF ACCESS TO A NAVIGABLE WATERWAY,
W68-01314 06E

AMERICAN WATER RIGHTS LAW,
W68-01398 06E

CANALS
WATER IN WEST PAKISTAN,
W68-01054 06B

CARBONATE ROCKS
U S GEOLOGICAL SURVEY TRACER STUDY AMARGOSA DESERT, NYE COUNTY, NEVADA--PART I EXPLORATORY DRILLING, TRACER WELL CONSTRUCTION AND TESTING AND PRELIMINARY FINDINGS,
W68-01248 04B

CAST IRON
PERFORMANCE OF DUCTILE-IRON PIPE IN SOILS,
W68-01194 08G

CENTRAL VALLEY PROJECT
WATER RESOURCE DEVELOPMENT IN CALIFORNIA,
W68-01058 06B

CEREAL CROPS
EFFECTS OF REPEATED DROUGHT PERIODS ON PHOTOSYNTHESIS AND SURVIVAL OF CEREAL SEEDLINGS,
W68-01188 03F

CHANNEL EROSION
STREAMFLOW FLUCTUATION, BAR ROUGHNESS, AND BED LOAD MOVEMENT A HYPOTHESIS,
W68-01044 02E

CHANNEL FLOW
VARIATIONS OF THE HYDRAULIC ROUGHNESS OF ALLUVIAL CHANNELS,
W68-01273 08B

CHANNEL MORPHOLOGY
VARIATIONS OF THE HYDRAULIC ROUGHNESS OF ALLUVIAL CHANNELS,
W68-01273 08B

CHANNELS
STREAMFLOW FLUCTUATION, BAR ROUGHNESS, AND BED LOAD MOVEMENT A HYPOTHESIS,
W68-01044 02E

DESIGNING THE APPROACH CHANNEL FOR SHAFT SPILLWAYS,
W68-01226 08B

CHEMICAL ANALYSIS
DETERMINATION OF MOLYBDENUM IN FRESH WATERS - A COMPARISON OF METHODS,
W68-01046 02K

USE OF MERCUROUS CHLORIDE TO RECOVER TRACE AMOUNTS OF GOLD FROM WATERS,
W68-01124 02K

A FLEXIBLE COMPUTER PROGRAM FOR EVALUATION OF EMISSION SPECTROMETRIC DATA,
W68-01252 07C

CHEMICAL PROPERTIES
PHYSICAL-CHEMICAL PROPERTIES OF NATURALLY OCCURRING POLYELECTROLYTES--(PART) 1, SODIUM HUMATE,
W68-01253 02K

CITIES
DECISIONS RELATING TO DISTRIBUTION OF PUBLIC WATER SUPPLIES,
W68-01374 03D

CITY PLANNING
WATER DATA FOR METROPOLITAN AREAS,
W68-01027 07A

CIVIL LAW
COMMON, PUBLIC, AND PRIVATE THINGS IN LOUISIANA CIVILIAN TRADITION AND MODERN PRACTICE (WATERBODIES),
W68-01340 06E

CLASSIFICATION
CLASSES OF WATER AND CHARACTER OF WATER RIGHTS AND USES - SECTION 52 THE PRINCIPAL CATEGORIES OF SURFACE AND GROUND WATERS,
W68-01291 06E

CLAY MINERALS
FILTRATION RATES OF GROUND WATERS,
W68-01136 02G

CLAYS
SPECIES TRIALS IN THE SEMI-ARID SOUTHWEST OF NEW SOUTH WALES PART II--NATIVE SHRUB TRIALS IN THE HAY DISTRICT,
W68-01075 03F

LONG-TERM DEFORMATION IN CLAY,
W68-01198 08D

CLIMATIC DATA
A MONTHLY CLIMATIC FACTOR FOR THE WIND EROSION EQUATION,
W68-01086 02G

CLIMATOLOGY
OBSERVATIONS ONMICROCLIMATE AND VEGETATION INTERRELATIONSHIPS ON THE ACCRA PLAINS (GHANA),
W68-01077 02D

CONDITIONAL PROBABILITY OF OCCURRENCE FOR VARIATIONS IN CLIMATE BASED ON WIDTHS OF ANNUAL TREE RINGS IN ARIZONA,
W68-01251 02B

PRECIPITATION CLIMATOLOGY OF LAKE MICHIGAN BASIN,
W68-01254 02B

CLOUD SEEDING
A STATISTICAL INVESTIGATION OF PERSISTENCE IN THE ISRAELI ARTIFICIAL RAINFALL STIMULATION EXPERIMENT,
W68-01094 03B

CLOUDBURSTS
FLOOD OF MARCH 24, 1967, KIHEI AND OLOWALU AREAS, ISLAND OF MAUI, HAWAII,
W68-01133 02E

COFFERDAMS
ANALYSIS OF THE STABILITY OF COFFERDAMS WITH DOUBLE SHEET WALLS ACCORDING TO FIELD AND MODEL TESTS,
W68-01228 08A

COLUMBIA RIVER BASIN
THE COLUMBIA RIVER TREATY,
W68-01064 06E

COMPETING USES
LAND USE IMPLICATIONS OF SURFACE WATER ALLOCATION, CH 1 AND 2,
W68-01308 06D

LAND USE IMPLICATIONS OF SURFACE WATER ALLOCATION, CH 3 AND 4,
W68-01309 06D

CAN WATER BE ALLOCATED BY COMPETITIVE PRICES,
W68-01383 06C

WATER LAW AND PRIVATE DECISION-MAKING A CRITIQUE,
W68-01397 06D

AMERICAN WATER RIGHTS LAW,
W68-01398 06E

COMPUTER MODELS
ECONOMIC ANALYSIS OF ALTERNATIVE FLOOD CONTROL MEASURES,
W68-01052 06F

COMPUTER PROGRAMS
SAND DISPERSION IN A LABORATORY FLUME,
W68-01247 02J

A FLEXIBLE COMPUTER PROGRAM FOR EVALUATION OF EMISSION SPECTROMETRIC DATA,
W68-01252 07C

CONCRETE DAMS
MEASURING INTERNAL TEMPERATURES IN MASS CONCRETE,
W68-01203 08G

CONDUCTIVITY
WATER LEVEL PROBE,
W68-01021 07B

CONJUNCTIVE USE
OPTIMIZING CONJUNCTIVE USE OF SURFACE WATER AND GROUNDWATER,
W68-01155 02A

CONSERVATION
WATER PURITY A STUDY IN LEGAL CONTROL OF NATURAL RESOURCES,
W68-01361 06E

CONSTRAINTS
MATHEMATICAL MODELS THE MULTISTRUCTURE APPROACH MORE PERIODS, PREDICTABLE HYDROLOGY,
W68-01163 06A

CONSUMPTIVE USE
THE EFFECTS OF VARYING LAND AND WATER USE ON STREAMFLOW REGIMEN,
W68-01261 04C

(THE NEED FOR RECONSIDERATION OF THE NAVIGATION SERVITUDE),
W68-01299 06E

AN ECONOMIC VIEW WATER PROBLEMS - NATIONAL AND REGIONAL,
W68-01318 06D

CONTINENTAL SHELF
THE MUNIMENTS OF TITLE OF MASSACHUSETTS TO HER SUBMERGED SEA LANDS,
W68-01395 06E

CONTROL SYSTEMS
ELECTRICAL WATER LEVEL AND FLOW INDICATION AND CONTROL,
W68-01238 07B

CONVECTION
ONSET OF THERMOHALINE CONVECTION IN A POROUS MEDIUM,
W68-01038 08B

METHODS FOR PREDICTING DISPERSION COEFFICIENTS IN NATURAL STREAMS, WITH APPLICATIONS TO LOWER REACHES OF THE GREEN AND DUWAMISH RIVERS, WASH.,
W68-01145 02E

CONVERTERS(ELECTRICAL)
RESULTS IN HVDC CONVERTOR TESTING AND UTILIZATION OF THE RHEINAU RESEARCH LABORATORY FACILITIES,
W68-01219 08C

COOLING WATER
ANALYZING STEAM ELECTRIC POWER PLANT DISCHARGES,
W68-01026 05B

CORRELATION ANALYSIS
CONDITIONAL PROBABILITY OF OCCURRENCE FOR VARIATIONS IN CLIMATE BASED ON WIDTHS OF ANNUAL TREE RINGS IN ARIZONA,
W68-01251 02B

CORROSION
PERFORMANCE OF DUCTILE-IRON PIPE IN SOILS,
W68-01194 08G

COST ALLOCATION
COMMONALITY, THE PRICE SYSTEM, AND USE OF WATER SUPPLIES,
W68-01399 06C

COST REPAYMENT
SIX FEDERAL RECLAMATION PROJECTS AND THE DISTRIBUTION OF INCOME,
W68-01056 06B

COST-BENEFIT ANALYSIS
SIX FEDERAL RECLAMATION PROJECTS AND THE DISTRIBUTION OF INCOME,
W68-01056 06B

COST-BENEFIT RATIO
RED RIVER BELOW DENISON DAM, LOUISIANA, ARKANSAS, OKLAHOMA AND TEXAS.
W68-01032 06B

FEATHER RIVER NEAR CHESTER, CALIFORNIA (FLOOD CONTROL).
W68-01037 04A

THE ANIMAL FARM A MATHEMATICAL MODEL FOR THE DISCUSSION OF SOCIAL STANDARDS FOR CONTROL OF THE ENVIRONMENT,
W68-01157 06B

PROGRESS REPORT ON WEST TEXAS AND EASTERN NEW MEXICO IMPORT PROJECT INVESTIGATION.
W68-01271 03F

COTTON
RELATIVE TURGIDITY TECHNIQUE FOR SCHEDULING COTTON (GOSSYPIUM BIRSUTUM) IRRIGATION,
W68-01066 03F

INFLUENCES OF PLANT MOISTURE STRESS, SOLAR RADIATION, AND AIR TEMPERATURE ON COTTON LEAF TEMPERATURE,
W68-01071 03F

CRATERING
THEORETICAL STUDIES OF CRATERING MECHANISMS AFFECTING THE STABILITY OF CRATERED SLOPES,
W68-01195 08D

CRATERS
THEORETICAL STUDIES OF CRATERING MECHANISMS AFFECTING THE STABILITY OF CRATERED SLOPES,
W68-01195 08D

CREEP
LONG-TERM DEFORMATION IN CLAY,
W68-01198 08D

CROP PRODUCTION
A PRELIMINARY STUDY ON THE EFFECT OF ARTIFICIALLY CREATED LAYERS IN SANDY SOILS ON YIELD OF ALFALFA,
W68-01099 03F

CULTIVATION
SPRING SLOPE RUNOFF FROM THE PRINCIPAL AGRICULTURAL LANDS OF THE KULUNDA STEPPE,
W68-01170 02C

CURRENTS(WATER)
SEDIMENTATION IN ONSLOW BAY (IN GUIDEBOOK FOR FIELD EXCURSIONS, GEOLOGICAL SOCIETY OF AMERICA, SOUTHEASTERN SECTION),
W68-01262 02L

CYTOLOGICAL STUDIES
SOME PHYSICAL ASPECTS OF INTERNAL CONTROL OF LEAF TRANSPIRATION,
W68-01109 02D

DAM DESIGN
CRIB DAMS FOR CONTROL OF SEDIMENT AND STREAMBED EROSION AND THEIR SUITABILITY FOR CONDITIONS IN PAKISTAN,
W68-01179 08D

DAM FOUNDATIONS
DIFFERENCES BETWEEN EUROPEAN AND AMERICAN PRACTICE IN THE USE OF GROUT CURTAINS IN ROCK FOUNDATIONS,
W68-01210 08E

DAMAGES
COLBERG, INC V STATE RIPARIAN LANDOWNER'S RIGHT TO EMINENT DOMAIN RELIEF FOR STATE IMPAIRMENT OF ACCESS TO A NAVIGABLE WATERWAY,
W68-01314 06E

DECISIONS RELATING TO DISTRIBUTION OF PUBLIC WATER SUPPLIES,
W68-01374 03D

DAMS
WATER IN WEST PAKISTAN,
W68-01054 06B

FILL A LAKE, START AN EARTHQUAKE,
W68-01220 08E

RELATIONSHIPS BETWEEN WATER AND OTHER PROPERTY RIGHTS AND SMALL WATERSHED DEVELOPMENT IN THE EASTERN STATES,
W68-01325 04D

DARCYS LAW
FILTRATION RATES OF GROUND WATERS,
W68-01136 02G

DARCY'S LAW
NONSTEADY-STATE FLOW IN PHREATIC AQUIFERS,
W68-01227 02F

DATA COLLECTIONS
WATER DATA FOR METROPOLITAN AREAS,
W68-01027 07A

GROUND-WATER RESOURCES OF UPTON COUNTY, TEXAS,
W68-01036 04B

HYDROLOGIC DATA FOR EXPERIMENTAL AGRICULTURAL WATERSHEDS IN THE UNITED STATES, 1962,
W68-01121 04D

HYDROLOGIC AND CLIMATOLOGIC DATA, 1967, SALT LAKE COUNTY, UTAH,
W68-01135 02A

SELECTED HYDROLOGIC DATA, SAN PITCH RIVER DRAINAGE BASIN, UTAH,
W68-01146 03B

GROUND-WATER RESOURCES OF WOOD COUNTY, TEXAS,
W68-01250 04B

HYDROLOGIC DATA 1966 VOLUME 3--CENTRAL COASTAL AREA, APPENDICES A-E.
W68-01259 02A

HYDROLOGIC DATA 1966 VOLUME V--SOUTHERN CALIFORNIA, APPENDICES A-C.
W68-01260 02A

GROUND-WATER LEVELS IN NEW MEXICO, 1966,
W68-01266 04B

DATA PROCESSING
A FLEXIBLE COMPUTER PROGRAM FOR EVALUATION OF EMISSION SPECTROMETRIC DATA,
W68-01252 07C

DATA TRANSMISSION
AUTOMATED WATER QUALITY MONITORING,
W68-01049 05A

DECISION MAKING
INCOME REDISTRIBUTION EFFECTS AND BENEFIT-COST ANALYSIS,
W68-01050 06C

DECOMPOSITION
REVIEW OF THE METABOLISM AND DECOMPOSITION OF DIQUAT AND PARAQUAT,
W68-01275 05A

DEFORMATION
LONG-TERM DEFORMATION IN CLAY,
W68-01198 08D

DEGLACIATION
DEVELOPMENT, LANDFORMS AND CHRONOLOGY OF GENERATOR LAKE, BAFFIN ISLAND, N W T,
W68-01035 02C

DENDROCHRONOLOGY
CONDITIONAL PROBABILITY OF OCCURRENCE FOR VARIATIONS IN CLIMATE BASED ON WIDTHS OF ANNUAL TREE RINGS IN ARIZONA,
W68-01251 02B

DESALINATION
WATER RESEARCH AND DEVELOPMENT.
W68-01323 03A

DESALINATION PLANTS
NEW CONCEPTS FOR DESALTING BRACKISH WATER,
W68-01126 03A

WATER RESEARCH AND DEVELOPMENT.

W68-01323 03A

DESERT
WATER BALANCE IN DESERT ARTHROPODS,
W68-01069 02I

DESERTS
RECLAMATION OF THE RAJPUTANA DESERT,
W68-01242 04A

DICHLOBENIL
THE EFFECT OF DICHLOBENIL AND DICAMBA ON NODAL TISSUES OF ALLIGATORWEED,
W68-01278 04A

ABSORPTION, TRANSLOCATION, AND METABOLISM OF C-14-LABELED DICHLOBENIL,
W68-01283 04A

DICOTS
XEROPHYTIC STRUCTURES IN THE ROOTS OF DESERT SHRUBS,
W68-01170 02I

DIFFUSION
DISPERSION OF MASS IN OPEN-CHANNEL FLOW,
W68-01129 08B

METHODS FOR PREDICTING DISPERSION COEFFICIENTS IN NATURAL STREAMS, WITH APPLICATIONS TO LOWER REACHES OF THE GREEN AND DUWAMISH RIVERS, WASH.,
W68-01145 02E

DIGITAL COMPUTERS
IDENTIFICATION OF AQUIFER PARAMETERS BY DECOMPOSITION AND MULTILEVEL OPTIMIZATION,
W68-01047 02F

A FLEXIBLE COMPUTER PROGRAM FOR EVALUATION OF EMISSION SPECTROMETRIC DATA,
W68-01252 07C

DIQUAT
FACTORS AFFECTING PERSISTENCE AND INACTIVATION OF DIQUAT AND PARAQUAT,
W68-01274 05B

REVIEW OF THE METABOLISM AND DECOMPOSITION OF DIQUAT AND PARAQUAT,
W68-01275 05A

PHOTOCHEMICAL DECOMPOSITION OF DIQUAT AND PARAQUAT,
W68-01276 05A

PERSISTENCE OF DIQUAT, PARAQUAT, AND 2,4-DBEE WHEN USED FOR EURASIAN WATERMILFOIL CONTROL,
W68-01279 04A

INTERACTION OF DIPYRIDYLIUM HERBICIDES AND SOIL MICROORGANISMS,
W68-01282 05B

DIRECT CURRENT
RESEARCH ON ELECTRORECLAMATION OF SALINE-ALKALI SOILS,
W68-01108 02K

DIRECT CURRENTS
A TECHNICAL AND ECONOMIC COMPARISON BETWEEN AC AND DC TRANSMISSION,
W68-01217 08C

STUDIES ON THE INTEGRATION OF A D-C TRANSMISSION LINE INTO AN A-C NETWORK,
W68-01218 08C

RESULTS IN HVDC CONVERTOR TESTING AND UTILIZATION OF THE RHEINAU RESEARCH LABORATORY FACILITIES,
W68-01219 08C

DISCHARGE MEASUREMENT
GENERAL PROCEDURE FOR GAGING STREAMS,
W68-01138 07A

ULTRASONIC METHOD OF FLOW MEASUREMENT,
W68-01240 07B

DISPERSION
DYNAMICALLY SIMILAR MOTION OF TWO MISCIBLE CONSTITUENTS IN POROUS MEDIUMS,
W68-01031 02G

DISPERSION OF MASS IN OPEN-CHANNEL FLOW,
W68-01129 08B

METHODS FOR PREDICTING DISPERSION COEFFICIENTS IN NATURAL STREAMS, WITH APPLICATIONS TO LOWER REACHES OF THE GREEN AND DUWAMISH RIVERS, WASH.,
W68-01145 02E

DISPERSION IN LAYERED POROUS MEDIA,
W68-01178 08D

SAND DISPERSION IN A LABORATORY FLUME,
W68-01247 02J

DISSOLVED SOLIDS
DISSOLVED-MINERAL INFLOW TO GREAT SALT LAKE AND CHEMICAL CHARACTERISTICS OF THE SALT LAKE BRINE SUMMARY FOR WATER YEARS 1960, 1961, AND 1964,
W68-01249 02E

DISTRIBUTION PATTERNS
GRAIN SIZE DISTRIBUTION AND ITS EFFECT ON THE PERMEABILITY OF UNCONSOLIDATED SANDS,
W68-01175 02G

DISTRIBUTION SYSTEMS
THE HIERARCHY OF WATER QUALITY,
W68-01257 03D

DIVERSION
TRANSFER OF RIPARIAN RIGHT TO USE WATER TO NONRIPARIAN LAND.
W68-01372 06E

DIVERSION STRUCTURES
FEATHER RIVER NEAR CHESTER, CALIFORNIA (FLOOD CONTROL).
W68-01037 04A

DOCKS
NAVIGABLE WATERS - RIGHTS OF RIPARIAN OWNER HELD NOT TO INCLUDE THE RIGHT TO CONSTRUCT A PERMANENT DEEP WATER DOCK INTO LAKE HURON,
W68-01329 04C

DRAINAGE
DEPTH OF DRAINAGE IN IRRIGATED AREAS,
W68-01231 04A

DRILLING
U S GEOLOGICAL SURVEY TRACER STUDY AMARGOSA DESERT, NYE COUNTY, NEVADA--PART I EXPLORATORY DRILLING, TRACER WELL CONSTRUCTION AND TESTING AND PRELIMINARY FINDINGS,
W68-01248 04B

DROUGHT RESISTANCE
TRANSPIRATION PATTERNS OF WHEAT, BARLEY AND OAT SEEDLINGS UNDER VARYING CONDITIONS OF SOIL MOISTURE,
W68-01190 03F

DROUGHT TOLERANCE
EFFECTS OF REPEATED DROUGHT PERIODS ON PHOTOSYNTHESIS AND SURVIVAL OF CEREAL SEEDLINGS,
W68-01188 03F

DROUGHTS
WHAT IS DROUGHT,
W68-01100 02E

GEORGIA WATER LAW, USE AND CONTROL FACTORS,
W68-01402 06D

DRY SEASON
OBSERVATIONS ONMICROCLIMATE AND VEGETATION INTERRELATIONSHIPS ON THE ACCRA PLAINS (GHANA),
W68-01077 02D

DRY SEASONS
A STATISTICAL INVESTIGATION OF PERSISTENCE IN THE ISRAELI ARTIFICIAL RAINFALL STIMULATION EXPERIMENT,
W68-01094 03B

DRYING
STUDIES OF THE DRYING OF BARE GROUND,
W68-01076 02D

DURATION CURVES
STREAMS IN DUTCHESS COUNTY, NEW YORK--THEIR FLOW CHARACTERISTICS AND WATER QUALITY IN RELATION TO WATER PROBLEMS,
W68-01042 04A

DYNAMIC PROGRAMMING
A COMMENT ON OPTIMIZATION METHODS FOR BRANCHING MULTISTAGE WATER RESOURCE SYSTEMS,
W68-01158 06A

EARTH DAMS
STABILITY OF DAMS ERECTED OF LOCAL MATERIALS UNDER DYNAMIC LOADS,
W68-01208 08D

MANGLA INSTRUMENTATION,
W68-01239 07B

EARTH MOVEMENTS
STABILITY OF DAMS ERECTED OF LOCAL MATERIALS UNDER DYNAMIC LOADS,
W68-01208 08D

GEODIMETER FAULT MOVEMENT INVESTIGATIONS IN CALIFORNIA,
W68-01224 08E

EARTH PRESSURES
THE EFFECT OF PLACEMENT METHOD ON THE RESPONSE OF SOIL STRESS GAGES,
W68-01202 08D

RIGID PIPES IN SYMMETRICAL AND UNSYMMETRICAL TRENCHES,
W68-01207 08D

EARTHQUAKES
FILL A LAKE, START AN EARTHQUAKE,
W68-01220 08E

GEODIMETER FAULT MOVEMENT INVESTIGATIONS IN CALIFORNIA,
W68-01224 08E

EASEMENTS
AGREEMENT IN RESPECT OF WATER RIGHTS IN STREAM AS CREATING A MERE PERSONAL OBLIGATION, COVENANT RUNNING WITH THE LAND, OR AN EASEMENT.
W68-01373 06E

RIGHTS AND DUTIES OF OWNERS INTER SE WITH RESPECT TO UPKEEP AND REPAIR OF WATER EASEMENT,
W68-01375 06E

ECOLOGY
AN ECOSYSTEMS APPROACH TO PUBLIC LAND POLICY,
W68-01206 06G

ECONOMIC EFFICIENCY
WATER RESOURCE DEVELOPMENT IN CALIFORNIA,
W68-01058 06B

THE COLUMBIA RIVER TREATY,
W68-01064 06E

BALAS ALGORITHM FOR ZONED UNIFORM TREATMENT,
W68-01161 05D

CAN WATER BE ALLOCATED BY COMPETITIVE PRICES,
W68-01383 06C

COMMONALITY, THE PRICE SYSTEM, AND USE OF WATER SUPPLIES,
W68-01399 06C

ECONOMIC EVALUATION
POLICIES FOR WATER LAW PROPERTY RIGHTS, ECONOMIC FORCES, AND PUBLIC REGULATION,
W68-01312 06B

ECONOMIC IMPACT
GROUND WATER IN ECONOMIC DEVELOPMENT,
W68-01090 03F

ECONOMICS
OPTIMAL GROUND-WATER MINING,
W68-01110 06A

WATER ECONOMICS RELATIONS TO LAW AND POLICY,
W68-01295 06E

THE ROLE OF ECONOMIC EVALUATION IN PLANNING FOR WATER RESOURCE DEVELOPMENT,
W68-01332 06B

EFFICIENCIES
INCOME REDISTRIBUTION EFFECTS AND BENEFIT-COST ANALYSIS,
W68-01050 06C

EFFLUENTS
A STUDY IN THE ECONOMICS OF WATER QUALITY MANAGEMENT,
W68-01051 05G

ELASTICITY OF DEMAND
THE IMPACT OF PRICE ON RESIDENTIAL WATER DEMAND AND ITS RELATION TO SYSTEM DESIGN AND PRICE STRUCTURE,
W68-01053 06D

ELECTRIC ANALOGS
ELECTRONIC ANALOG MODELING AS AN AID IN WATER RESOURCE INVESTIGATIONS,
W68-01232 03B

ELECTRIC CABLES
TRANSIENT RECOVERY VOLTAGE CAUSED BY DIFFERENT SWITCHING OPERATIONS IN HV NETWORKS CONTAINING UNDERGROUND CABLES,
W68-01211 08C

1100-KV STATION AND LINE INSULATION DESIGN,
W68-01214 08C

ELECTRIC INSULATION
1100-KV STATION AND LINE INSULATION DESIGN,
W68-01214 08C

ELECTRIC RELAYS
EXPERIENCE WITH TRANSISTORISED PROTECTION IN BRITAIN,
W68-01215 08C

HIGH SPEED PROTECTION OF POWER SYSTEMS BASED ON IMPROVED POWER SYSTEM MODELS,
W68-01216 08C

ELECTRONIC EQUIPMENT
EXPERIENCE WITH TRANSISTORISED PROTECTION IN BRITAIN,
W68-01215 08C

EMBANKMENTS
SUBCRITICAL FLOW OVER HIGHWAY EMBANKMENTS,
W68-01022 08B

LONG-TERM DEFORMATION IN CLAY,
W68-01198 08D

EMINENT DOMAIN
PUBLIC RIGHTS IN INDIANA WATERS,
W68-01337 06E

ENERGY ABSORPTION
ENERGY ABSORPTION IN HIGH-VELOCITY CURRENTS,
W68-01221 08B

ENERGY DISSIPATION
ENERGY ABSORPTION IN HIGH-VELOCITY CURRENTS,
W68-01221 08B

SOME STUDIES ON NEW TYPES OF FRICTION BLOCKS,
W68-01258 08B

ENGINEERING GEOLOGY
APPLICATION OF SEISMIC EXPLORATION METHODS IN ENGINEERING-GEOLOGICAL INVESTIGATIONS,
W68-01223 08E

ENVIRONMENTAL EFFECTS
XEROPHYTIC STRUCTURES IN THE ROOTS OF DESERT SHRUBS,
W68-01170 02I

ENVIRONMENTAL ENGINEERING
THE ANIMAL FARM A MATHEMATICAL MODEL FOR THE DISCUSSION OF SOCIAL STANDARDS FOR CONTROL OF THE ENVIRONMENT,
W68-01157 06B

EPHEMERAL STREAMS
HYDROGRAPHS OF EPHEMERAL STREAMS IN THE SOUTHWEST,
W68-01092 04A

EQUATIONS
A MONTHLY CLIMATIC FACTOR FOR THE WIND EROSION EQUATION,
W68-01086 02G

THEORETICAL PREDICTION OF EVAPORATION LOSSES FROM GROUNDWATER,
W68-01172 02D

THE ADJUSTMENT OF RADAR ESTIMATES OF STORM MEAN RAINFALL WITH RAIN GAGE DATA,
W68-01180 02B

EROSION
RATES OF EROSION AND SOIL FORMATION (IN THE HUMID AND ARID SUBTROPICS OF THE USSR),
W68-01169 02J

ERRORS
EXPRESSION OF THE UNCERTAINTIES OF FINAL RESULTS,
W68-01204 07C

ESTUARIES
USE OF SYSTEMS ANALYSIS IN ESTUARINE WATER POLLUTION CONTROL,
W68-01162 05G

DELAWARE ESTUARY COMPREHENSIVE STUDY, PRELIMINARY REPORT AND FINDINGS.
W68-01167 05G

SUSPENDED SEDIMENT OF THE NORTHERN CHESAPEAKE BAY,
W68-01268 02L

EUTROPHICATION
MANIPULATION OF RESERVOIR WATER FOR IMPROVED QUALITY AND FISH POPULATION RESPONSE.
W68-01143 05C

EUTROPHICATION IS BEGINNING IN LAKE MICHIGAN,
W68-01244 05C

EVALUATION
THE COLUMBIA RIVER TREATY,
W68-01064 06E

EVAPORATION
EVAPOTRANSPIRATION AND THE WATER BUDGET OF PRAIRIE POTHOLES IN NORTH DAKOTA,
W68-01043 02D

STUDIES OF THE DRYING OF BARE GROUND,
W68-01076 02D

THEORETICAL PREDICTION OF EVAPORATION LOSSES FROM GROUNDWATER,
W68-01172 02D

EFFECT OF TALLOW ALCOHOL ADDED TO SOIL ON THE TENSION, FLOW, AND EVAPORATION OF SOIL WATER,
W68-01173 02G

EVAPORATION CONTROL
RAFTS NEW WAY TO CONTROL EVAPORATION,
W68-01067 03F

PLANNING FOR WATER RESOURCE DEVELOPMENT.
W68-01185 06B

RETARDATION OF EVAPORATION FROM OPEN WATER STORAGES,
W68-02256 03B

EVAPOTRANSPIRATION
EVAPOTRANSPIRATION AND THE WATER BUDGET OF PRAIRIE POTHOLES IN NORTH DAKOTA,
W68-01043 02D

EVAPOTRANSPIRATION RATES OF FIELD CROPS DETERMINED BY THE BOWEN RATIO METHOD,
W68-01106 03F

EXPERIMENTAL DATA
EXPRESSION OF THE UNCERTAINTIES OF FINAL RESULTS,
W68-01204 07C

EXPLOSIONS
THEORETICAL STUDIES OF CRATERING MECHANISMS AFFECTING THE STABILITY OF CRATERED SLOPES,
W68-01195 08D

EXTERNALITIES
WATER RESOURCES ALLOCATION, EXTRAMARKET VALUES, AND MARKET CRITERIA A SUGGESTED APPROACH,
W68-01111 06B

EXTRA HIGH VOLTAGE
1100-KV STATION AND LINE INSULATION DESIGN,

W68-01214 08C

RESULTS IN HVDC CONVERTOR TESTING AND UTILIZATION OF THE RHEINAU RESEARCH LABORATORY FACILITIES,
W68-01219 08C

FALLOWING
SPRING SLOPE RUNOFF FROM THE PRINCIPAL AGRICULTURAL LANDS OF THE KULUNDA STEPPE,
W68-01174 02C

FARM UNITS
INTEGRATING FARM AND WATERSHED PLANNING IN SOIL AND WATER RESOURCE MANAGEMENT,
W68-01234 03F

FAULTS(GEOLOGY)
GEODIMETER FAULT MOVEMENT INVESTIGATIONS IN CALIFORNIA,
W68-01224 08E

FEDERAL GOVERNMENT
PLAN AND SCOPE OF THE WORK (ON WATER AND WATER RIGHTS),
W68-01286 06E

REGULATORY ASPECTS OF FEDERAL POLLUTION CONTROL,
W68-01302 05G

WATER SUPPLY SUGGESTED FEDERAL REGULATION,
W68-01317 03B

TEN YEARS OF PROGRESS IN POLLUTION ABATEMENT.
W68-01321 05G

WATER MUSHROOMING POPULATIONS,
W68-01344 06D

FEDERAL JURISDICTION
(THE COMMERCE CLAUSE AND THE NAVIGATION POWER),
W68-01298 06E

(THE NEED FOR A NATIONAL WATER POLICY),
W68-01301 06E

FEDERAL POWER ACT
WATER SUPPLY SUGGESTED FEDERAL REGULATION,
W68-01317 03B

FEDERAL PROJECT POLICY
THE GREAT LAKES WATER RESOURCE,
W68-01305 05C

FEDERAL-STATE WATER RIGHTS CONFLICTS
(THE NEED FOR A NATIONAL WATER POLICY),
W68-01301 06E

FERTILITY CULTIVATION
RATES OF EROSION AND SOIL FORMATION (IN THE HUMID AND ARID SUBTROPICS OF THE USSR),
W68-01169 02J

FERTILIZERS
TIME OF FERTILIZER APPLICATION ON DESERT GRASSLANDS,
W68-01068 03F

FIRST ORDER SURVEYS
GEODIMETER FAULT MOVEMENT INVESTIGATIONS IN CALIFORNIA,
W68-01224 08E

FISH MANAGEMENT
MANIPULATION OF RESERVOIR WATER FOR IMPROVED QUALITY AND FISH POPULATION RESPONSE.
W68-01143 05C

FISH POPULATIONS
SOUTHWESTERN FISHES AND THE ENIGMA OF 'ENDANGERED SPECIES',
W68-01102 06G

FLASH DISTILLATION
NEW CONCEPTS FOR DESALTING BRACKISH WATER,
W68-01126 03A

FLOATS
ELECTRICAL WATER LEVEL AND FLOW INDICATION AND CONTROL,
W68-01238 07B

FLOOD CONTROL
CUCAMONGA CREEK, SAN BERNARDINO AND RIVERSIDE COUNTIES, CALIFORNIA (FLOOD CONTROL PROPOSAL).
W68-01033 06F

FEATHER RIVER NEAR CHESTER, CALIFORNIA (FLOOD CONTROL).
W68-01037 04A

ECONOMIC ANALYSIS OF ALTERNATIVE FLOOD CONTROL MEASURES,
W68-01052 06F

WATER IN WEST PAKISTAN,
W68-01058 06B

FLOOD DAMAGE
CUCAMONGA CREEK, SAN BERNARDINO AND RIVERSIDE COUNTIES, CALIFORNIA (FLOOD CONTROL PROPOSAL).
W68-01033 06F

ECONOMIC ANALYSIS OF ALTERNATIVE FLOOD CONTROL MEASURES,
W68-01052 06F

AVERAGE PROBABILITY OF EXTREME EVENTS,
W68-01059 06F

FLOOD PLAIN ZONING
CUCAMONGA CREEK, SAN BERNARDINO AND RIVERSIDE COUNTIES, CALIFORNIA (FLOOD CONTROL PROPOSAL).
W68-01033 06F

STATE FLOOD-PLAIN ZONING.
W68-01315 06F

ZONING ON THE FLOOD PLAIN,
W68-01316 06F

FLOOD PLAINS
ZONING ON THE FLOOD PLAIN,
W68-01316 06F

FLOOD ROUTING
CUCAMONGA CREEK, SAN BERNARDINO AND RIVERSIDE COUNTIES, CALIFORNIA (FLOOD CONTROL PROPOSAL).
W68-01033 06F

FLOODPROOFING
ECONOMIC ANALYSIS OF ALTERNATIVE FLOOD CONTROL MEASURES,
W68-01052 06F

FLOODS
MAGNITUDE AND FREQUENCY OF FLOODS IN THE UNITED STATES PART 5. HUDSON BAY AND UPPER MISSISSIPPI RIVER BASIN,
W68-01023 02E

FEATHER RIVER NEAR CHESTER, CALIFORNIA (FLOOD CONTROL).
W68-01037 04A

STREAMS IN DUTCHESS COUNTY, NEW YORK--THEIR FLOW CHARACTERISTICS AND WATER QUALITY IN RELATION TO WATER PROBLEMS,
W68-01042 04A

AVERAGE PROBABILITY OF EXTREME EVENTS,
W68-01059 06F

FLOOD OF MARCH 24, 1967, KIHEI AND OLOWALU AREAS, ISLAND OF MAUI, HAWAII,
W68-01133 02E

FLOODS IN THE MAYAGUEZ AREA OF PUERTIO RICO,
W68-01272 03B

FLOODWAYS
FEATHER RIVER NEAR CHESTER, CALIFORNIA (FLOOD CONTROL).
W68-01037 04A

FLORIDA
GROUNDWATER FLOW AND THE GEOTHERMAL REGIME OF THE FLORIDIAN PLATEAU,
W68-01270 02F

PALM BEACH COUNTY WATER AND SEWER ACT.
W68-01303 04A

THE ADMINISTRATION OF WATER LAWS IN FLORIDA,
W68-01356 06C

FLOW
DISPERSION IN LAYERED POROUS MEDIA,
W68-01178 08D

CHARACTERISTICS OF INTERFACE FLOW IN SUBSURFACE DISPOSAL SYSTEMS,
W68-01245 05G

FLOW AROUND OBJECTS
ON WAKES IN STRATIFIED FLUIDS,
W68-01040 08B

FLOW CHARACTERISTICS
MAGNITUDE AND FREQUENCY OF FLOODS IN THE UNITED STATES PART 5. HUDSON BAY AND UPPER MISSISSIPPI RIVER BASIN,
W68-01023 02E

FLOW CONTROL
ELECTRICAL WATER LEVEL AND FLOW INDICATION AND CONTROL,
W68-01238 07B

FLOW MEASUREMENT
SUBCRITICAL FLOW OVER HIGHWAY EMBANKMENTS,
W68-01022 08B

ANALYSIS OF SUBMERGENCE IN FLOW MEASURING FLUMES,
W68-01123 08B

FLOW METERS
ELECTRICAL WATER LEVEL AND FLOW INDICATION AND CONTROL,
W68-01238 07B

FLOW RATES
FLOW PATTERN AND RELATED CHEMICAL QUALITY OF GROUND WATER IN THE '500-FOOT' SAND IN THE MEMPHIS AREA, TENNESSEE,
W68-01130 02F

EFFECT OF TALLOW ALCOHOL ADDED TO SOIL ON THE TENSION, FLOW, AND EVAPORATION OF SOIL WATER,
W68-01173 02G

FLOWMETERS
GENERAL PROCEDURE FOR GAGING STREAMS,
W68-01138 07A

FLOW-RATES
GROUNDWATER SEEPAGE RATES,
W68-01237 02F

FLUID FRICTION

SOME STUDIES ON NEW TYPES OF FRICTION BLOCKS,
W68-01258 08B

FLUMES
SAND DISPERSION IN A LABORATORY FLUME,
W68-01247 02J

FLUOMETURON
METABOLISM OF FLUOMETURON BY SEVERAL BIOLOGICAL SYSTEMS,
W68-01281 05A

FLUORIDATION
SELECTIVE ION ELECTRODE SYSTEM FOR FLUORIDE ANALYSIS,
W68-01116 07B

FOOTINGS
THE USE OF SOIL MECHANICS METHODS FOR ADAPTING TOWER FOUNDATIONS TO SOIL CONDITIONS,
W68-01212 08D

FORECASTING
ELECTRICAL-ANALOG ANALYSIS OF GROUND-WATER DEPLETION IN CENTRAL ARIZONA,
W68-01034 04B

FOREIGN COUNTRIES
PRIVATE WATER RIGHTS IN FRANCE AND IN THE EASTERN UNITED STATES,
W68-01320 06E

FOUNDATIONS
THE USE OF SOIL MECHANICS METHODS FOR ADAPTING TOWER FOUNDATIONS TO SOIL CONDITIONS,
W68-01212 08D

FROST
EFFECTS OF TEMPERATURE AND PRESSURE ON UNFROZEN SOIL WATER,
W68-01264 02C

FURROW IRRIGATION
FACTORS AFFECTING THE EMERGENCE OF SUGAR BEETS IN AN IRRIGATED DESERT ENVIRONMENT,
W68-01187 03F

FUTURE PLANNING
A SYMPOSIUM ON SUPPLEMENTAL IRRIGATION.
W68-01396 03F

FUTURE PLANNING(PROJECTED)
FUTURE WATER REQUIREMENTS.
W68-01184 06D

PLANNING FOR WATER RESOURCE DEVELOPMENT.
W68-01185 06B

QUESTIONS FOR DESIGNERS OF FUTURE WATER POLICY,
W68-01343 06B

GAGES
THE EFFECT OF PLACEMENT METHOD ON THE RESPONSE OF SOIL STRESS GAGES,
W68-01202 08D

GAGING STATIONS
GENERAL PROCEDURE FOR GAGING STREAMS,
W68-01138 07A

GENERATOR LAKE
DEVELOPMENT, LANDFORMS AND CHRONOLOGY OF GENERATOR LAKE, BAFFIN ISLAND, N W T,
W68-01035 02C

GEOCHEMISTRY
CHEMICAL GEOHYDROLOGY,
W68-01263 02K

GEODIMETERS
GEODIMETER FAULT MOVEMENT INVESTIGATIONS IN CALIFORNIA,
W68-01224 08E

GEOLOGIC INVESTIGATIONS
GEOLOGY AND GROUND-WATER RESOURCES OF THE LOWER BIGHORN VALLEY, MONTANA,
W68-01144 04B

GEOMORPHOLOGY
DEVELOPMENT, LANDFORMS AND CHRONOLOGY OF GENERATOR LAKE, BAFFIN ISLAND, N W T,
W68-01035 02C

WATER RIGHTS LAW IN KENTUCKY - WATER SUPPLY OF KENTUCKY.
W68-01387 03B

GEORGIA
GEORGIA WATER LAW, USE AND CONTROL FACTORS,
W68-01402 06D

GEOTHERMAL STUDIES
GROUNDWATER FLOW AND THE GEOTHERMAL REGIME OF THE FLORIDIAN PLATEAU,
W68-01270 02F

GERMINATION
MOISTURE AND TEMPERATURE REQUIREMENTS FOR GERMINATION OF THREE ANNUAL SPECIES OF MEDICAGO,
W68-01107 02I

FACTORS AFFECTING THE EMERGENCE OF SUGAR BEETS IN AN IRRIGATED DESERT ENVIRONMENT,
W68-01187 03F

GLACIERS
HYDROLOGY OF THE LEWIS GLACIER, NORTH-CENTRAL BAFFIN ISLAND, N W T, AND DISCUSSION OF RELIABILITY OF THE MEASUREMENTS.
W68-01041 02C

GOLD
USE OF MERCUROUS CHLORIDE TO RECOVER TRACE AMOUNTS OF GOLD FROM WATERS,
W68-01124 02K

GOVERNMENT FINANCE
TEN YEARS OF PROGRESS IN POLLUTION ABATEMENT.
W68-01321 05G

GRANTS
WATER RESOURCES RESEARCH PROGRAM.
W68-01306 06E

WATER RESOURCES PLANNING.
W68-01307 06B

WATER QUALITY CONTROL ACT OF 1965.
W68-01359 05G

WATER RESOURCES RESEARCH PROGRAM.
W68-01371 06D

GRASSES
SPECIES TRIALS IN THE SEMI-ARID SOUTHWEST OF NEW SOUTH WALES PART I--GRASSES AND LEGUMES,
W68-01074 03F

GRASSLANDS
OBSERVATIONS ONMICROCLIMATE AND VEGETATION INTERRELATIONSHIPS ON THE ACCRA PLAINS (GHANA),
W68-01077 02D

GRAVELS
GEOLOGY AND GROUND-WATER RESOURCES OF THE LOWER BIGHORN VALLEY, MONTANA,
W68-01144 04B

GRAVITY DAMS
MEASURING INTERNAL TEMPERATURES IN MASS CONCRETE,
W68-01203 08G

GRAZING
EFFECT OF GRAZING ON INFILTRATION IN A WESTERN WATERSHED,
W68-01105 04D

GREAT LAKES
THE GREAT LAKES WATER RESOURCE,
W68-01305 05C

GREAT SALT LAKE
DISSOLVED-MINERAL INFLOW TO GREAT SALT LAKE AND CHEMICAL CHARACTERISTICS OF THE SALT LAKE BRINE SUMMARY FOR WATER YEARS 1960, 1961, AND 1964,
W68-01249 02E

GROUND WATER
COMMON LAW RULES REGARDING THE USE OF SURFACE AND GROUND WATER IN THE SOUTHEASTERN STATES,
W68-01349 06E

GROUNDWATER
GROUND-WATER RESOURCES OF CHOWAN COUNTY, NORTH CAROLINA,
W68-01024 04B

GROUNDWATER CONDITIONS IN THE WATERMAN WASH AREA, MARICOPA AND PINAL COUNTIES, ARIZONA,
W68-01028 04B

DYNAMICALLY SIMILAR MOTION OF TWO MISCIBLE CONSTITUENTS IN POROUS MEDIUMS,
W68-01031 02G

ELECTRICAL-ANALOG ANALYSIS OF GROUND-WATER DEPLETION IN CENTRAL ARIZONA,
W68-01034 04B

GROUND-WATER RESOURCES OF UPTON COUNTY, TEXAS,
W68-01036 04B

FRESH AND SALINE GROUND-WATER ZONES IN THE PUNJAB REGION, WEST PAKISTAN,
W68-01039 03C

TEMPORAL ALLOCATION OF GROUNDWATER,
W68-01060 06C

QUALITY OF GROUNDWATER FOR IRRIGATION IN AHOR DEVELOPMENT BLOCK, JALORE DISTRICT, WESTERN RAJASTHAN,
W68-01091 03C

AVAILABILITY OF GROUND WATER IN THE OAKTON QUADRANGLE AND PART OF THE WOLF ISLAND QUADRANGLE IN JACKSON PURCHASE REGION, KENTUCKY,
W68-01117 04B

HYDROLOGICAL YEAR-BOOK OF ISRAEL 1965/66.
W68-01119 02A

AVAILABILITY OF GROUND WATER IN THE HICKMAN QUADRANGLE, KENTUCKY-MISSOURI-TENNESSEE,
W68-01122 03B

FLOW PATTERN AND RELATED CHEMICAL QUALITY OF GROUND WATER IN THE '500-FOOT' SAND IN THE MEMPHIS AREA, TENNESSEE,
W68-01130 02F

AVAILABILITY OF GROUND WATER IN THE PARTS OF THE WICKLIFFE AND WICKLIFFE NW QUADRANGLES IN JACKSON PURCHASE REGION, KENTUCKY,
W68-01132 04B

AVAILABILITY OF GROUND WATER IN PARTS OF THE CAIRO AND BARLOW QUADRANGLES IN THE JACKSON PURCHASE REGION, KENTUCKY,
W68-01134 04B

HYDROLOGIC AND CLIMATOLOGIC DATA, 1967, SALT LAKE COUNTY, UTAH,
W68-01135 02A

MINERALS AND WATER, BUTLER COUNTY, ALABAMA.
W68-01137 03B

GROUND-WATER RESOURCES OF THE APPALACHIAN REGION,
W68-01140 03B

WATER RESOURCES OF THE SALISBURY AREA, MARYLAND,
W68-01141 03B

GEOLOGY AND GROUND-WATER RESOURCES OF THE LOWER BIGHORN VALLEY, MONTANA,
W68-01144 04B

SELECTED HYDROLOGIC DATA, SAN PITCH RIVER DRAINAGE BASIN, UTAH,
W68-01146 03B

SUMMARY OF THE GEOLOGY AND GROUND-WATER RESOURCES OF PITT COUNTY, NORTH CAROLINA,
W68-01147 04B

THEORETICAL PREDICTION OF EVAPORATION LOSSES FROM GROUNDWATER,
W68-01172 02D

INTEGRATING MANAGEMENT OF GROUND AND IMPORTED WATER IN LOS ANGELES COUNTY,
W68-01193 03D

NONSTEADY-STATE FLOW IN PHREATIC AQUIFERS,
W68-01227 02F

GROUND-WATER RESOURCES OF WOOD COUNTY, TEXAS,
W68-01250 04B

HYDROLOGIC DATA 1966 VOLUME 3--CENTRAL COASTAL AREA, APPENDICES A-E.
W68-01259 02A

HYDROLOGIC DATA 1966 VOLUME V--SOUTHERN CALIFORNIA, APPENDICES A-C.
W68-01260 02A

CHEMICAL GEOHYDROLOGY,
W68-01263 02K

GEOLOGY AND GROUND WATER RESOURCES OF THE KALISPELL VALLEY, NORTHWESTERN MONTANA,
W68-01265 04B

GROUND-WATER LEVELS IN NEW MEXICO, 1966,
W68-01266 04B

GEOLOGY AND WATER RESOURCES OF THE HIBBING AREA, NORTHEASTERN MINNESOTA,
W68-01267 04B

CLASSES OF WATER AND CHARACTER OF WATER RIGHTS AND USES - SECTION 52 THE PRINCIPAL CATEGORIES OF SURFACE AND GROUND WATERS,
W68-01291 06E

GROUNDWATER BASINS
THE OPTIMUM MANAGEMENT OF GROUND WATER RESOURCES,
W68-01156 04B

GROUNDWATER FLOW
FIELD AND LABORATORY EXPERIMENTAL APPROACHES,
W68-01233 02E

GROUNDWATER MINING
GROUND WATER IN ECONOMIC DEVELOPMENT,
W68-01090 03F

LAND SUBSIDENCE ALONG THE DELTA-MENDOTA CANAL, CALIFORNIA,
W68-01127 08A

GROUNDWATER MOVEMENT
FILTRATION RATES OF GROUND WATERS,
W68-01136 02G

GROUNDWATER FLOW AND THE GEOTHERMAL REGIME OF THE FLORIDIAN PLATEAU,
W68-01270 02F

GROUNDWATER RECHARGE
WATER CONSERVATION BY RECLAMATION AND RECHARGE,
W68-01048 05D

NATURAL RECHARGE IN TUCSON BASIN,
W68-01080 04B

GROWTH AND DECAY OF GROUNDWATER-MOUNDS IN RESPONSE TO UNIFORM PERCOLATION,
W68-01083 04B

EFFECTS OF SURFACE SEDIMENTS ON GROUNDWATER RECHARGE,
W68-01085 04B

BOUNDARY FLOW IN LABORATORY PERMEAMETERS USED TO STIMULATE RECHARGE BY CYCLIC WATER SPREADING,
W68-01120 02G

GROUND-WATER MINING
OPTIMAL GROUND-WATER MINING,
W68-01110 06A

GROUT CURTAINS
DIFFERENCES BETWEEN EUROPEAN AND AMERICAN PRACTICE IN THE USE OF GROUT CURTAINS IN ROCK FOUNDATIONS,
W68-01210 08E

GROUTING
DIFFERENCES BETWEEN EUROPEAN AND AMERICAN PRACTICE IN THE USE OF GROUT CURTAINS IN ROCK FOUNDATIONS,
W68-01210 08E

HALOPHYTES
GEOGRAPHIC DISTRIBUTION AND FACTORS AFFECTING THE DISTRIBUTION OF SALT DESERT SHRUBS IN THE UNITED STATES,
W68-01176 02I

HAZARDS
LIABILITY RESULTING FROM ARTIFICIAL BODIES OF WATER.
W68-01338 06E

HEAT FLOW
GROUNDWATER FLOW AND THE GEOTHERMAL REGIME OF THE FLORIDIAN PLATEAU,
W68-01270 02F

HEAT RESISTANCE
RESISTANCE OF TEXAS SALT - AND FRESHWATER - MARSH FISHES TO HEAT DEATH AT VARIOUS SALINITIES,
W68-01073 05C

HERBICIDES
THE CONTROL OF WATER WEEDS,
W68-01235 04A

FACTORS AFFECTING PERSISTENCE AND INACTIVATION OF DIQUAT AND PARAQUAT,
W68-01274 05B

REVIEW OF THE METABOLISM AND DECOMPOSITION OF DIQUAT AND PARAQUAT,
W68-01275 05A

PHOTOCHEMICAL DECOMPOSITION OF DIQUAT AND PARAQUAT,
W68-01276 05A

CHEMICALS MAY CONTROL STUBBORN ALLIGATORWEED,
W68-01277 04A

THE EFFECT OF DICHLOBENIL AND DICAMBA ON NODAL TISSUES OF ALLIGATORWEED,
W68-01278 04A

PERSISTENCE OF DIQUAT, PARAQUAT, AND 2,4-DBEE WHEN USED FOR EURASIAN WATERMILFOIL CONTROL,
W68-01279 04A

EFFECTIVENESS OF HERBICIDAL COMBINATIONS ON ALLIGATORWEED GROWING IN FLOWING WATER,
W68-01280 04A

METABOLISM OF FLUOMETURON BY SEVERAL BIOLOGICAL SYSTEMS,
W68-01281 05A

INTERACTION OF DIPYRIDYLIUM HERBICIDES AND SOIL MICROORGANISMS,
W68-01282 05B

ABSORPTION, TRANSLOCATION, AND METABOLISM OF C-14-LABELED DICHLOBENIL,
W68-01283 04A

HISTORIC FLOOD
FLOOD OF MARCH 24, 1967, KIHEI AND OLOWALU AREAS, ISLAND OF MAUI, HAWAII,
W68-01133 02E

HISTORY
BASES OF RESOURCE REGULATION,
W68-01362 06E

ENGLISH WATER LAW DOCTRINES BEFORE 1400,
W68-01379 06E

WATER RIGHTS LAW IN KENTUCKY -- HISTORICAL DEVELOPMENT OF KENTUCKY WATER LAW.
W68-01386 06E

HUMIC ACIDS
PHYSICAL-CHEMICAL PROPERTIES OF NATURALLY OCCURRING POLYELECTROLYTES--(PART) 1, SODIUM HUMATE,
W68-01253 02K

HYDRAULIC CONDUCTIVITY
BULK VOLUME AND HYDRAULIC CONDUCTIVITY CHANGES DURING SODIUM SATURATION TESTS,
W68-01070 02G

BOUNDARY FLOW IN LABORATORY PERMEAMETERS USED TO STIMULATE RECHARGE BY CYCLIC WATER SPREADING,
W68-01120 02G

HYDRAULIC DESIGN
SOME STUDIES ON NEW TYPES OF FRICTION BLOCKS,

W68-01258 08B

HYDRAULIC MACHINERY
UNIDIRECTIONAL REVERSE HONE SYSTEM PUMP TURBINE,
W68-01225 08C

HYDRAULIC TURBINE CONSTRUCTION IN THE USSR,
W68-01229 08C

HYDRAULIC MODELS
ENERGY ABSORPTION IN HIGH-VELOCITY CURRENTS,
W68-01221 08B

HYDRAULIC TURBINES
HYDRAULIC TURBINE CONSTRUCTION IN THE USSR,
W68-01229 08C

INFLUENCE OF A METHOD OF AIR ADMISSION ON PRESSURE SURGES IN DRAFT TUBE MODELS OF AXIAL HYDRO-TURBINES,
W68-01230 08B

HYDRAULICS
ANALYSIS OF SUBMERGENCE IN FLOW MEASURING FLUMES,
W68-01123 08B

DISPERSION OF MASS IN OPEN-CHANNEL FLOW,
W68-01129 08B

NONSTEADY-STATE FLOW IN PHREATIC AQUIFERS,
W68-01227 02F

HYDROELECTRIC POWER
OPTIMAL POLICY FOR HYDROELECTRIC OPERATIONS,
W68-01150 08C

HYDROGEOLOGY
EXAMPLES OF RECENT ADVANCES IN ANALYTICAL TECHNIQUES FOR EVALUATING AQUIFERS,
W68-01118 07A

CHEMICAL GEOHYDROLOGY,
W68-01263 02K

GEOLOGY AND WATER RESOURCES OF THE HIBBING AREA, NORTHEASTERN MINNESOTA,
W68-01267 04B

HYDROGRAPHS
STREAMS IN DUTCHESS COUNTY, NEW YORK--THEIR FLOW CHARACTERISTICS AND WATER QUALITY IN RELATION TO WATER PROBLEMS,
W68-01042 04A

HYDROGRAPHS OF EPHEMERAL STREAMS IN THE SOUTHWEST,
W68-01092 04A

HYDROLOGIC DATA FOR EXPERIMENTAL AGRICULTURAL WATERSHEDS IN THE UNITED STATES, 1962,
W68-01121 04D

FIELD AND LABORATORY EXPERIMENTAL APPROACHES,
W68-01233 02E

HYDROLOGIC ASPECTS
WHAT IS DROUGHT,
W68-01100 02E

OPTIMAL GROUND-WATER MINING,
W68-01110 06A

HYDROLOGIC BUDGET
THE EFFECTS OF VARYING LAND AND WATER USE ON STREAMFLOW REGIMEN,
W68-01261 04C

HYDROLOGIC CYCLE
WATER SUPPLY SUGGESTED FEDERAL REGULATION,
W68-01317 03B

HYDROLOGIC DATA
MAGNITUDE AND FREQUENCY OF FLOODS IN THE UNITED STATES PART 5. HUDSON BAY AND UPPER MISSISSIPPI RIVER BASIN,
W68-01023 02E

GROUND-WATER RESOURCES OF CHOWAN COUNTY, NORTH CAROLINA,
W68-01024 04B

WATER DATA FOR METROPOLITAN AREAS,
W68-01027 07A

GROUNDWATER CONDITIONS IN THE WATERMAN WASH AREA, MARICOPA AND PINAL COUNTIES, ARIZONA,
W68-01028 04B

GROUND-WATER RESOURCES OF UPTON COUNTY, TEXAS,
W68-01036 04B

AVAILABILITY OF GROUND WATER IN THE OAKTON QUADRANGLE AND PART OF THE WOLF ISLAND QUADRANGLE IN JACKSON PURCHASE REGION, KENTUCKY,
W68-01117 04B

HYDROLOGICAL YEAR-BOOK OF ISRAEL 1965/66.
W68-01119 02A

HYDROLOGIC DATA FOR EXPERIMENTAL AGRICULTURAL WATERSHEDS IN THE UNITED STATES, 1962,
W68-01121 04D

AVAILABILITY OF GROUND WATER IN THE HICKMAN QUADRANGLE, KENTUCKY-MISSOURI-TENNESSEE,
W68-01122 03B

AVAILABILITY OF GROUND WATER IN THE PARTS OF THE WICKLIFFE AND WICKLIFFE NW QUADRANGLES IN JACKSON PURCHASE REGION, KENTUCKY,
W68-01132 04B

AVAILABILITY OF GROUND WATER IN PARTS OF THE CAIRO AND BARLOW QUADRANGLES IN THE JACKSON PURCHASE REGION, KENTUCKY,
W68-01134 04B

HYDROLOGIC AND CLIMATOLOGIC DATA, 1967, SALT LAKE COUNTY, UTAH,
W68-01135 02A

GROUND-WATER RESOURCES OF THE APPALACHIAN REGION,
W68-01140 03B

SELECTED HYDROLOGIC DATA, SAN PITCH RIVER DRAINAGE BASIN, UTAH,
W68-01146 03B

SUMMARY OF THE GEOLOGY AND GROUND-WATER RESOURCES OF PITT COUNTY, NORTH CAROLINA,
W68-01147 04B

GROUND-WATER RESOURCES OF WOOD COUNTY, TEXAS,
W68-01250 04B

HYDROLOGIC DATA 1966 VOLUME 3--CENTRAL COASTAL AREA, APPENDICES A-E.
W68-01259 02A

HYDROLOGIC DATA 1966 VOLUME V--SOUTHERN CALIFORNIA, APPENDICES A-C.
W68-01260 02A

HYDROLOGY
CUCAMONGA CREEK, SAN BERNARDINO AND RIVERSIDE COUNTIES, CALIFORNIA (FLOOD CONTROL PROPOSAL).
W68-01033 06F

HYDROLYSIS
ADSORPTION CATALYZED CHEMICAL HYDROLYSIS OF ATRAZINE,
W68-01246 03F

ILLINOIS
STATE FLOOD-PLAIN ZONING.
W68-01315 06F

DIVERSION OF LAKE MICHIGAN WATERS,
W68-01380 05E

IMPOUNDMENTS
EASTERN LAWS CONCERNING MINIMUM STREAM FLOWS AND IMPOUNDMENTS,
W68-01357 06E

IMPULSE TESTS(ELECTRICAL)
1100-KV STATION AND LINE INSULATION DESIGN,
W68-01214 08C

INCOME
WATER-ORIENTED OUTDOOR RECREATION,
W68-01112 06D

TAX PROBLEMS RELATING TO WATER RIGHTS AND WATERWORKS - DIV C SPECIAL TAXES ON WATER AND ELECTRIC COMPANIES - DIV D FEDERAL INCOME TAX PROBLEMS RELATING TO WATER RIGHTS AND H2O WKS,
W68-01297 06E

INDIANA
A FOUR STATE COMPARATIVE ANALYSIS OF PUBLIC RIGHTS IN WATER,
W68-01310 06B

INDUSTRIAL WASTES
PILOT PLANT STUDIES ON THE ANAEROBIC TREATMENT OF TANNERY EFFLUENTS,
W68-01125 05D

INDUSTRIAL WATER
WATER COSTS.
W68-01183 06C

INDUSTRIES
WAR AGAINST WATER POLLUTION GETS MORE LIVELY.
W68-01304 05G

INFILTRATION
MODIFICATION OF THE PERMEABILITY OF LOESS BY ELECTROLYTES,
W68-01098 02G

EFFECT OF GRAZING ON INFILTRATION IN A WESTERN WATERSHED,
W68-01105 04D

BOUNDARY FLOW IN LABORATORY PERMEAMETERS USED TO STIMULATE RECHARGE BY CYCLIC WATER SPREADING,
W68-01120 02G

INORGANIC COMPOUNDS
DETERMINATION OF MOLYBDENUM IN FRESH WATERS - A COMPARISON OF METHODS,
W68-01046 02K

INSECTICIDES
INSECTICIDES IN TILE DRAINAGE EFFLUENT,
W68-01191 05G

INSTRUMENTATION
WATER LEVEL PROBE,

W68-01021 07B

AUTOMATED WATER QUALITY MONITORING,
W68-01049 05A

GENERAL PROCEDURE FOR GAGING STREAMS,
W68-01138 07A

THE EFFECT OF PLACEMENT METHOD ON THE RESPONSE OF SOIL STRESS GAGES,
W68-01202 08D

MANGLA INSTRUMENTATION,
W68-01239 07B

ROCK MECHANICS INSTRUMENTATION IN TUNNELS,
W68-01241 07B

INTANGIBLE BENEFITS
THE ANIMAL FARM A MATHEMATICAL MODEL FOR THE DISCUSSION OF SOCIAL STANDARDS FOR CONTROL OF THE ENVIRONMENT,
W68-01157 06B

INTERFACES
CHARACTERISTICS OF INTERFACE FLOW IN SUBSURFACE DISPOSAL SYSTEMS,
W68-01245 05G

INTERNATIONAL JOINT COMMISSION
WATER POLLUTION CONTROL IN THE GREAT LAKES REGION,
W68-01392 05G

INTERNATIONAL WATERS
DIVERSION OF LAKE MICHIGAN WATERS,
W68-01380 05E

INTER-BASIN TRANSFERS
INTERIM APPRAISAL OF OKLAHOMA BASINS PROJECT, OKLAHOMA WATER--THE KEY TO OKLAHOMA'S FUTURE.
W68-01131 06B

PROGRESS REPORT ON WEST TEXAS AND EASTERN NEW MEXICO IMPORT PROJECT INVESTIGATION.
W68-01271 03F

INVESTMENT
WATER IN WEST PAKISTAN,
W68-01054 06B

IOWA
WATER RIGHTS IN IOWA,
W68-01384 06E

IRRIGATION PROGRAMS
WATER IN WEST PAKISTAN,
W68-01096 06E

IRRIGATED LAND
PRESENT USES AND WATER ECONOMY.
W68-01182 06B

INSECTICIDES IN TILE DRAINAGE EFFLUENT,
W68-01191 05G

IRRIGATION
WATER IN WEST PAKISTAN,
W68-01054 06B

RELATIVE TURGIDITY TECHNIQUE FOR SCHEDULING COTTON (GOSSYPIUM BIRSUTUM) IRRIGATION,
W68-01066 03F

A COMPARISON OF GYPSUM BLOCKS AND EVAPORIMETERS FOR IRRIGATION CONTROL,
W68-01104 03F

PROGRESS REPORT ON WEST TEXAS AND EASTERN NEW MEXICO IMPORT PROJECT INVESTIGATION.
W68-01271 03F

IRRIGATION DESIGN
SUGAR CANE IRRIGATION A CASE STUDY IN CAPITAL BUDGETING,
W68-01164 03F

IRRIGATION DISTRICTS
A SOCIALLY OPTIMUM PRICING POLICY FOR A PUBLIC WATER AGENCY,
W68-01057 06C

IRRIGATION EFFECTS
EFFECT OF SOIL MOISTURE DEPLETION ON CROP YIELD AND STOMATAL INFILTRATION,
W68-01189 03F

IRRIGATION EFFICIENCY
INDUS RIVER BASIN STUDIES.
W68-01148 03C

SUGAR CANE IRRIGATION A CASE STUDY IN CAPITAL BUDGETING,
W68-01164 03F

IRRIGATION PRACTICES
RECLAMATION OF ANCIENT AGRICULTURAL SOILS IN WAHIDI, SOUTH ARABIA,
W68-01177 03C

IRRIGATION PROGRAMS
SIX FEDERAL RECLAMATION PROJECTS AND THE DISTRIBUTION OF INCOME,
W68-01056 06B

FUTURE WATER REQUIREMENTS.
W68-01184 06D

IRRIGATION SYSTEMS
USE OF MODERN EQUIPMENT AND TECHNIQUES IN THE PLANNING AND DEVELOPMENT OF WATER RESOURCES,
W68-01160 06A

IRRIGATION WATER
QUALITY OF GROUNDWATER FOR IRRIGATION IN AHOR DEVELOPMENT BLOCK, JALORE DISTRICT, WESTERN RAJASTHAN,
W68-01091 03C

THE EFFECTS OF VARYING LAND AND WATER USE ON STREAMFLOW REGIMEN,
W68-01261 04C

IRRIGATION WELLS
INDUS RIVER BASIN STUDIES.
W68-01148 03C

JUDICIAL DECISIONS
COLBERG, INC V STATE RIPARIAN LANDOWNER'S RIGHT TO EMINENT DOMAIN RELIEF FOR STATE IMPAIRMENT OF ACCESS TO A NAVIGABLE WATERWAY,
W68-01314 06E

WATER RESOURCES LAW,
W68-01324 06E

AGREEMENT IN RESPECT OF WATER RIGHTS IN STREAM AS CREATING A MERE PERSONAL OBLIGATION, COVENANT RUNNING WITH THE LAND, OR AN EASEMENT.
W68-01373 06E

RIGHTS AND DUTIES OF OWNERS INTER SE WITH RESPECT TO UPKEEP AND REPAIR OF WATER EASEMENT,
W68-01375 06E

KAPLAN TURBINES
INFLUENCE OF A METHOD OF AIR ADMISSION ON PRESSURE SURGES IN DRAFT TUBE MODELS OF AXIAL HYDRO-TURBINES,
W68-01230 08B

KENTUCKY
WATER RIGHTS LAW IN KENTUCKY.
W68-01385 06E

WATER RIGHTS LAW IN KENTUCKY -- HISTORICAL DEVELOPMENT OF KENTUCKY WATER LAW.
W68-01386 06E

WATER RIGHTS LAW IN KENTUCKY - WATER SUPPLY OF KENTUCKY.
W68-01387 03B

WATER RIGHTS LAW IN KENTUCKY - WATER USE IN KENTUCKY.
W68-01388 03D

WATER RIGHTS LAW IN KENTUCKY - ALTERNATIVE LEGAL APPROACHES.
W68-01389 06E

KILLIFISHES
RESISTANCE OF TEXAS SALT - AND FRESHWATER - MARSH FISHES TO HEAT DEATH AT VARIOUS SALINITIES,
W68-01073 05C

KINETICS
SOURCES OF ERROR IN CALCULATING THE KINETIC ENERGY OF RAINFALL,
W68-01089 02B

LABORATORY TESTS
BOUNDARY FLOW IN LABORATORY PERMEAMETERS USED TO STIMULATE RECHARGE BY CYCLIC WATER SPREADING,
W68-01120 02G

LAKE MICHIGAN
EUTROPHICATION IS BEGINNING IN LAKE MICHIGAN,
W68-01244 05C

PRECIPITATION CLIMATOLOGY OF LAKE MICHIGAN BASIN,
W68-01254 02B

DIVERSION OF LAKE MICHIGAN WATERS,
W68-01380 05E

LAKES
RIPARIAN RIGHTS - INLAND WATERS - RIGHT OF AN OWNER OF LAND ABUTTING ON INTER-TRACT LAKE TO THE USE OF THE ENTIRE SURFACE,
W68-01328 06E

LAND FORMING
LANDFORMING FOR LEACHING OF SALINE SOILS IN A NONIRRIGATED AREA,
W68-01087 03F

LAND MANAGEMENT
AN ECOSYSTEMS APPROACH TO PUBLIC LAND POLICY,
W68-01206 06G

MULTIPLE LAND USE MANAGEMENT,
W68-01319 06B

LAND RECLAMATION
RESEARCH ON ELECTRORECLAMATION OF SALINE-ALKALI SOILS,
W68-01108 02K

RECLAMATION OF ANCIENT AGRICULTURAL SOILS IN WAHIDI, SOUTH ARABIA,
W68-01177 03C

RECLAMATION OF THE RAJPUTANA DESERT,
W68-01242 04A

LAND SUBSIDENCE
LAND SUBSIDENCE ALONG THE DELTA-MENDOTA CANAL, CALIFORNIA,
W68-01127 08A

LAND TENURE
PUBLIC RIGHTS IN WATER USES AND PRIVATE RIGHTS IN LAND ADJACENT TO WATER - DIVISION B PRIVATE RIGHTS IN LAND ADJACENT TO WATER,
W68-01289 06E

LAND USE
LAND USE IMPLICATIONS OF SURFACE WATER ALLOCATION, CH 3 AND 4,
W68-01309 06D

MULTIPLE LAND USE MANAGEMENT,
W68-01319 06B

LEAKAGE
FLOW OF GROUNDWATER IN RELATIVELY THICK LEAKY AQUIFERS,
W68-01186 02F

LEASES
IMPLIED COVENANT TO PROTECT LEASED PREMISES FROM DRAINAGE WHERE LESSEE IS RESPONSIBLE FOR DRAINAGE,
W68-01336 04C

LEGISLATION
PLAN AND SCOPE OF THE WORK (ON WATER AND WATER RIGHTS),
W68-01286 06E

CLASSES OF WATER AND CHARACTER OF WATER RIGHTS AND USES - SECTION 55 QUANTITY AND QUALITY OF SUPPLY,
W68-01294 06E

REGULATORY ASPECTS OF FEDERAL POLLUTION CONTROL,
W68-01302 05G

PALM BEACH COUNTY WATER AND SEWER ACT.
W68-01303 04A

WAR AGAINST WATER POLLUTION GETS MORE LIVELY.
W68-01304 05G

WATER RESOURCES RESEARCH PROGRAM.
W68-01306 06E

WATER RESOURCES PLANNING.
W68-01307 06B

STATE FLOOD-PLAIN ZONING.
W68-01315 06F

ZONING ON THE FLOOD PLAIN,
W68-01316 06F

TEN YEARS OF PROGRESS IN POLLUTION ABATEMENT.
W68-01321 05G

WASTE RECOVERY AND POLLUTION ABATEMENT,
W68-01322 05F

WATER RESEARCH AND DEVELOPMENT.
W68-01323 03A

WATER RESOURCES LAW,
W68-01324 06E

RELATIONSHIPS BETWEEN WATER AND OTHER PROPERTY RIGHTS AND SMALL WATERSHED DEVELOPMENT IN THE EASTERN STATES,
W68-01325 04D

STATE DISTRICT LAWS AS THEY AFFECT WATERSHED DEVELOPMENT,
W68-01326 04D

MODEL WATERSHED DISTRICT ACT,
W68-01327 04D

WATER SUPPLY ACT OF 1958.
W68-01342 06E

SOME CURRENT AND PROPOSED WATER-RIGHTS LEGISLATION IN THE EASTERN STATES,
W68-01347 06E

WATER LAW AND POLICY IN THE SOUTHEAST.
W68-01348 06E

STATUTES FOR ADMINISTERING WATER USE IN THE SOUTHEAST,
W68-01350 06E

MISSISSIPPI WATER-USE LAWS AND ADMINISTRATION,
W68-01351 06E

LEGAL BASIS FOR WATER POLLUTION CONTROL,
W68-01352 06E

WATER POLLUTION CONTROL IN NORTH CAROLINA,
W68-01353 06E

REGULATION OF WATER USE IN LOCAL AREAS BY STATE OR LOCAL GOVERNMENTS AND DISTRICTS,
W68-01355 06E

THE ADMINISTRATION OF WATER LAWS IN FLORIDA,
W68-01356 06C

WATER QUALITY CONTROL ACT OF 1965.
W68-01359 05G

WATER PURITY A STUDY IN LEGAL CONTROL OF NATURAL RESOURCES,
W68-01360 05G

W68-01361 06E

TRANSITION TO CENTRAL ADMINISTRATIVE CONTROL,
W68-01364 06E

DEVELOPMENT OF CENTRAL ADMINISTRATING CONTROL,
W68-01365 06E

HEARINGS ON S4 BEFORE A SPECIAL SUBCOMMITTEE ON AIR AND WATER POLLUTION OF THE COMMITTEE ON PUBLIC WORKS, UNITED STATES SENATE.
W68-01369 05G

W68-01370 05G

WATER RESOURCES RESEARCH PROGRAM.
W68-01371 06D

WATER RIGHTS LAW IN KENTUCKY -- HISTORICAL DEVELOPMENT OF KENTUCKY WATER LAW.
W68-01386 06E

OWNERSHIP OF BEDS OF NAVIGABLE WATERS,
W68-01393 06E

BOUNDARY PROBLEMS RAISED BY THE SUBMERGED LANDS ACT,
W68-01394 06E

LEGUMES
SPECIES TRIALS IN THE SEMI-ARID SOUTHWEST OF NEW SOUTH WALES PART I--GRASSES AND LEGUMES,
W68-01074 03F

LIGNINS
WATER QUALITY DEGRADATION BY WOOD BARK POLLUTANTS,
W68-01269 05C

LINEAR PROGRAMMING
INDUS RIVER BASIN STUDIES.
W68-01148 03C

LINEAR DYNAMIC DECOMPOSITION PROGRAMMING APPROACH TO LONG-RANGE OPTIMIZATION OF NORTHERN CALIFORNIA WATER RESOURCES SYSTEM, PART I DETERMINISTIC HYDROLOGY,
W68-01152 06A

COMPUTER MODELS FOR RESERVOIR REGULATION,
W68-01154 06A

OPTIMIZING CONJUNCTIVE USE OF SURFACE WATER AND GROUNDWATER,
W68-01155 02A

A COMMENT ON OPTIMIZATION METHODS FOR BRANCHING MULTISTAGE WATER RESOURCE SYSTEMS,
W68-01158 06A

LINEAR PROGRAMMING MODELS FOR WATER POLLUTION CONTROL,
W68-01159 05G

MATHEMATICAL MODELS THE MULTISTRUCTURE APPROACH MORE PERIODS, PREDICTABLE HYDROLOGY,
W68-01163 06A

SUGAR CANE IRRIGATION A CASE STUDY IN CAPITAL BUDGETING,
W68-01164 03F

A STUDY IN THE ECONOMICS OF WATER QUALITY MANAGEMENT,
W68-01165 05G

MATHEMATICAL MODELS THE MULTISTRUCTURE APPROACH ALLOWANCE FOR UNCERTAINTY,
W68-01166 06A

LOCAL GOVERNMENT
STATE DISTRICT LAWS AS THEY AFFECT WATERSHED DEVELOPMENT,
W68-01326 04D

LOCAL GOVERNMENTS
STATE FLOOD-PLAIN ZONING.
W68-01315 06F

ZONING ON THE FLOOD PLAIN,
W68-01316 06F

REGULATION OF WATER USE IN LOCAL AREAS BY STATE OR LOCAL GOVERNMENTS AND DISTRICTS,
W68-01355 06E

TRANSITION TO CENTRAL ADMINISTRATIVE CONTROL,
W68-01364 06E

LOESS
MODIFICATION OF THE PERMEABILITY OF LOESS BY ELECTROLYTES,
W68-01098 02G

LONG-TERM PLANNING
LINEAR DYNAMIC DECOMPOSITION PROGRAMMING APPROACH TO LONG-RANGE OPTIMIZATION OF NORTHERN CALIFORNIA WATER RESOURCES SYSTEM, PART I DETERMINISTIC HYDROLOGY,
W68-01152 06A

LOUISIANA
COMMON, PUBLIC, AND PRIVATE THINGS IN LOUISIANA CIVILIAN TRADITION AND MODERN PRACTICE (WATERBODIES),
W68-01340 06E

OWNERSHIP OF BEDS OF NAVIGABLE WATERS,
W68-01393 06E

LOW FLOW
EASTERN LAWS CONCERNING MINIMUM STREAM FLOWS AND IMPOUNDMENTS,
W68-01357 06E

MARKETING
WATER LAW AND PRIVATE DECISION-MAKING A CRITIQUE,
W68-01397 06D

WATER LAW AND DECISION-MAKING A CRITIQUE,
W68-01400 06C

MASS CONCRETE
MEASURING INTERNAL TEMPERATURES IN MASS CONCRETE,
W68-01203 08G

MASS TRANSFER
EVAPOTRANSPIRATION AND THE WATER BUDGET OF PRAIRIE POTHOLES IN NORTH DAKOTA,
W68-01043 02D

MASSACHUSETTS
THE MUNIMENTS OF TITLE OF MASSACHUSETTS TO HER SUBMERGED SEA LANDS,
W68-01395 06E

MATHEMATICAL MODELS
PROBABILISTIC MODELS FOR PREDICTING STREAM QUALITY,
W68-01149 05F

THE ANIMAL FARM A MATHEMATICAL MODEL FOR THE DISCUSSION OF SOCIAL STANDARDS FOR CONTROL OF THE ENVIRONMENT,
W68-01157 06B

A COMMENT ON OPTIMIZATION METHODS FOR BRANCHING MULTISTAGE WATER RESOURCE SYSTEMS,
W68-01158 06A

LINEAR PROGRAMMING MODELS FOR WATER POLLUTION CONTROL,
W68-01159 05G

MATHEMATICAL STUDIES
NONSTEADY-STATE FLOW IN PHREATIC AQUIFERS,
W68-01227 02F

MEASUREMENT
AUTOMATED WATER QUALITY MONITORING,
W68-01049 05A

EXPRESSION OF THE UNCERTAINTIES OF FINAL RESULTS,
W68-01204 07C

METABOLISM
REVIEW OF THE METABOLISM AND DECOMPOSITION OF DIQUAT AND PARAQUAT,
W68-01275 05A

METABOLISM OF FLUOMETURON BY SEVERAL BIOLOGICAL SYSTEMS,
W68-01281 05A

ABSORPTION, TRANSLOCATION, AND METABOLISM OF C-14-LABELED DICHLOBENIL,
W68-01283 04A

METHODOLOGY
COMPARISONS OF METHODS FOR RECREATION EVALUATION,
W68-01063 06B

MICHIGAN
NAVIGABLE WATERS - RIGHTS OF RIPARIAN OWNER HELD NOT TO INCLUDE THE RIGHT TO CONSTRUCT A PERMANENT DEEP WATER DOCK INTO LAKE HURON,
W68-01329 04C

MICHIGAN'S PURLOINED SHORELINES,
W68-01377 06E

MINING
BIG-HOLE DRILLING IS COMING OF AGE UNDERGROUND,
W68-01196 08H

MINNESOTA
A FOUR STATE COMPARATIVE ANALYSIS OF PUBLIC RIGHTS IN WATER,
W68-01310 06B

RIPARIAN RIGHTS - INLAND WATERS - RIGHT OF AN OWNER OF LAND ABUTTING ON INTER-TRACT LAKE TO THE USE OF THE ENTIRE SURFACE,
W68-01328 06E

MISSISSIPPI
IMPLIED COVENANT TO PROTECT LEASED PREMISES FROM DRAINAGE WHERE LESSEE IS RESPONSIBLE FOR DRAINAGE,
W68-01336 04C

MISSISSIPPI WATER-USE LAWS AND ADMINISTRATION,
W68-01351 06E

PROGRESS REPORT.
W68-01367 03B

MISSOURI
THE RIGHTS OF A RIPARIAN LANDOWNER IN MISSOURI,
W68-01390 06E

MISSOURI RIVER
AN ECONOMIC VIEW WATER PROBLEMS - NATIONAL AND REGIONAL,
W68-01318 06D

MIXING
METHODS FOR PREDICTING DISPERSION COEFFICIENTS IN NATURAL STREAMS, WITH APPLICATIONS TO LOWER REACHES OF THE GREEN AND DUWAMISH RIVERS, WASH.,
W68-01145 02E

MODEL STUDIES
SIMULATION OF A NATIONAL FLOOD INSURANCE FUND,
W68-01062 06F

MODEL TESTS
STUDIES ON THE INTEGRATION OF A D-C TRANSMISSION LINE INTO AN A-C NETWORK,
W68-01218 08C

ENERGY ABSORPTION IN HIGH-VELOCITY CURRENTS,
W68-01221 08B

DESIGNING THE APPROACH CHANNEL FOR SHAFT SPILLWAYS,
W68-01226 08B

MOISTURE STRESS
INFLUENCES OF PLANT MOISTURE STRESS, SOLAR RADIATION, AND AIR TEMPERATURE ON COTTON LEAF TEMPERATURE,
W68-01071 03F

MOISTURE STRESS IN A VEGETATIONAL CONTINUUM IN THE SONORAN DESERT,
W68-01103 03F

GEOGRAPHIC DISTRIBUTION AND FACTORS AFFECTING THE DISTRIBUTION OF SALT DESERT SHRUBS IN THE UNITED STATES,
W68-01176 02I

MOISTURE TENSION
EFFECT OF TALLOW ALCOHOL ADDED TO SOIL ON THE TENSION, FLOW, AND EVAPORATION OF SOIL WATER,
W68-01173 02G

MONITORING
AUTOMATED WATER QUALITY MONITORING,
W68-01049 05A

MONOMOLECULAR FILMS
RETARDATION OF EVAPORATION FROM OPEN WATER STORAGES,
W68-02256 03B

MULTIPLE PURPOSE
MULTIPLE LAND USE MANAGEMENT,
W68-01319 06B

MULTIPLE-PURPOSE PROJECTS
MATHEMATICAL MODELS THE MULTISTRUCTURE APPROACH TWO SEASONS, PREDICTABLE HYDROLOGY,
W68-01153 06A

USE OF MODERN EQUIPMENT AND TECHNIQUES IN THE PLANNING AND DEVELOPMENT OF WATER RESOURCES,
W68-01160 06A

MATHEMATICAL MODELS THE MULTISTRUCTURE APPROACH MORE PERIODS, PREDICTABLE HYDROLOGY,
W68-01163 06A

MATHEMATICAL MODELS THE MULTISTRUCTURE APPROACH ALLOWANCE FOR UNCERTAINTY,
W68-01166 06A

PROGRESS REPORT ON WEST TEXAS AND EASTERN NEW MEXICO IMPORT PROJECT INVESTIGATION.
W68-01271 03F

MUNICIPAL WATER
FLOW PATTERN AND RELATED CHEMICAL QUALITY OF GROUND WATER IN THE '500-FOOT' SAND IN THE MEMPHIS AREA, TENNESSEE,
W68-01130 02F

THE EFFECTS OF VARYING LAND AND WATER USE ON STREAMFLOW REGIMEN,
W68-01261 04C

NATURAL FLOW DOCTRINE
LIABILITY FOR DIVERSION OF SURFACE WATERS.
W68-01330 04C

HIGHWAYS - FLOOD DAMAGE - PROPOSED MODIFICATION OF COMMON ENEMY RULE,
W68-01339 04C

THE DEVELOPMENT OF RIPARIAN LAW IN ALABAMA,
W68-01401 06E

NATURAL GAS
IMPLIED COVENANT TO PROTECT LEASED PREMISES FROM DRAINAGE WHERE LESSEE IS RESPONSIBLE FOR DRAINAGE,
W68-01336 04C

NATURAL RECHARGE
NATURAL RECHARGE IN TUCSON BASIN,
W68-01080 04B

NAVIGABLE WATERS
PUBLIC RIGHTS IN WATER USES AND PRIVATE RIGHTS IN LAND ADJACENT TO WATER - DIV A TRADITIONAL RIGHTS OF THE PUBLIC IN WATER USES,
W68-01288 06E

(THE COMMERCE CLAUSE AND THE NAVIGATION POWER),
W68-01298 06E

(THE NEED FOR RECONSIDERATION OF THE NAVIGATION SERVITUDE),
W68-01299 06E

THE STATE V THE RIPARIAN A PROBLEM OF WATER USE AND CONTROL.
W68-01333 06E

NAVIGATION
RED RIVER BELOW DENISON DAM, LOUISIANA, ARKANSAS, OKLAHOMA AND TEXAS.
W68-01032 06B

A FOUR STATE COMPARATIVE ANALYSIS OF PUBLIC RIGHTS IN WATER,
W68-01310 06B

NEVADA
U S GEOLOGICAL SURVEY TRACER STUDY AMARGOSA DESERT, NYE COUNTY, NEVADA--PART I EXPLORATORY DRILLING, TRACER WELL CONSTRUCTION AND TESTING AND PRELIMINARY FINDINGS,
W68-01248 04B

NEW MEXICO
GROUND-WATER LEVELS IN NEW MEXICO, 1966,
W68-01266 04B

NEW YORK
WATER RESOURCES LAW,
W68-01324 06E

NON-NEWTONIAN FLOW
FILTRATION RATES OF GROUND WATERS,
W68-01136 02G

NON-STRUCTURAL ALTERNATIVES
ECONOMIC ANALYSIS OF ALTERNATIVE FLOOD CONTROL MEASURES,
W68-01052 06F

NORTH CAROLINA
LAND USE IMPLICATIONS OF SURFACE WATER ALLOCATION, CH 1 AND 2,
W68-01308 06D

WATER POLLUTION CONTROL IN NORTH CAROLINA,
W68-01353 06E

WATER USE LAW IN ACTION,
W68-01354 06E

REAL PROPERTY - RIPARIAN RIGHTS,
W68-01381 06E

NUCLEAR ENERGY
NEW CONCEPTS FOR DESALTING BRACKISH WATER,
W68-01126 03A

NUCLEAR ENGINEERING
POTENTIAL APPLICATIONS OF NUCLEAR EXPLOSIVES IN DEVELOPMENT AND MANAGEMENT OF WATER RESOURCES--PRELIMINARY CANVASS OF THE GROUND-WATER ENVIRONMENT,
W68-01142 08H

NUCLEAR EXPLOSIONS
POTENTIAL APPLICATIONS OF NUCLEAR EXPLOSIVES IN DEVELOPMENT AND MANAGEMENT OF WATER RESOURCES--PRELIMINARY CANVASS OF THE GROUND-WATER ENVIRONMENT,
W68-01142 08H

OBSTRUCTION TO FLOW
REAL PROPERTY - WATERS AND WATERCOURCES - LIABILITY FOR DAMAGE CAUSED BY OBSTRUCTION OF PERCOLATING WATERS.
W68-01334 04C

OHIO
A FOUR STATE COMPARATIVE ANALYSIS OF PUBLIC RIGHTS IN WATER,
W68-01310 06B

LIABILITY FOR DIVERSION OF SURFACE WATERS.
W68-01330 04C

OPEN CHANNEL
SUBCRITICAL FLOW OVER HIGHWAY EMBANKMENTS,
W68-01022 08B

OPEN CHANNEL FLOW
ANALYSIS OF SUBMERGENCE IN FLOW MEASURING FLUMES,
W68-01123 08B

DISPERSION OF MASS IN OPEN-CHANNEL FLOW,
W68-01129 08B

OPTIMIZATION
OPTIMAL GROUND-WATER MINING,
W68-01110 06A

OPTIMIZING CONJUNCTIVE USE OF SURFACE WATER AND GROUNDWATER,
W68-01155 02A

THE OPTIMUM MANAGEMENT OF GROUND WATER RESOURCES,
W68-01156 04B

OPTIMUM DEVELOPMENT PLANS
SOME PHYSICAL, TECHNOLOGICAL, AND ECONOMIC CHARACTERISTICS OF WATER AND WATER RESOURCES SISTEMS IMPLICATIONS FOR ADMINISTRATION,
W68-01341 06B

OVERDRAFT
NATURAL RECHARGE IN TUCSON BASIN,
W68-01080 04B

OWNERSHIP OF BEDS
PUBLIC RIGHTS IN INDIANA WATERS,
W68-01337 06E

MICHIGAN'S PURLOINED SHORELINES,
W68-01377 06E

OWNERSHIP OF BEDS OF NAVIGABLE WATERS,
W68-01393 06E

BOUNDARY PROBLEMS RAISED BY THE SUBMERGED LANDS ACT,
W68-01394 06E

THE MONUMENTS OF TITLE OF MASSACHUSETTS TO HER SUBMERGED SEA LANDS,
W68-01395 06E

OXYGEN REQUIREMENTS
MANIPULATION OF RESERVOIR WATER FOR IMPROVED QUALITY AND FISH POPULATION RESPONSE.
W68-01143 05C

LINEAR PROGRAMMING MODELS FOR WATER POLLUTION CONTROL,
W68-01159 05G

PALEOCLIMATOLOGY
CONDITIONAL PROBABILITY OF OCCURRENCE FOR VARIATIONS IN CLIMATE BASED ON WIDTHS OF ANNUAL TREE RINGS IN ARIZONA,
W68-01251 02B

PARAMETRIC HYDROLOGY
LINEAR DYNAMIC DECOMPOSITION PROGRAMMING APPROACH TO LONG-RANGE OPTIMIZATION OF NORTHERN CALIFORNIA WATER RESOURCES SYSTEM, PART I DETERMINISTIC HYDROLOGY,
W68-01152 06A

GRAIN SIZE DISTRIBUTION AND ITS EFFECT ON THE PERMEABILITY OF UNCONSOLIDATED SANDS,
W68-01175 02G

PARAQUAT
FACTORS AFFECTING PERSISTENCE AND INACTIVATION OF DIQUAT AND PARAQUAT,
W68-01274 05B

REVIEW OF THE METABOLISM AND DECOMPOSITION OF DIQUAT AND PARAQUAT,
W68-01275 05A

PHOTOCHEMICAL DECOMPOSITION OF DIQUAT AND PARAQUAT,
W68-01276 05A

PERSISTENCE OF DIQUAT, PARAQUAT, AND 2,4-DBEE WHEN USED FOR EURASIAN WATERMILFOIL CONTROL,
W68-01279 04A

INTERACTION OF DIPYRIDYLIUM HERBICIDES AND SOIL MICROORGANISMS,
W68-01282 05B

PARTICLE SIZE
GRAIN SIZE DISTRIBUTION AND ITS EFFECT ON THE PERMEABILITY OF UNCONSOLIDATED SANDS,
W68-01175 02G

PATH OF POLLUTANTS
ANALYZING STEAM ELECTRIC POWER PLANT DISCHARGES,
W68-01026 05B

METHODS FOR PREDICTING DISPERSION COEFFICIENTS IN NATURAL STREAMS, WITH APPLICATIONS TO LOWER REACHES OF THE GREEN AND DUWAMISH RIVERS, WASH.,
W68-01145 02E

PEAK DISCHARGE
HYDROGRAPHS OF EPHEMERAL STREAMS IN THE SOUTHWEST,
W68-01092 04A

PENETRATION
MICROMORPHOLOGICAL STUDY OF SOIL CRUSTS,
W68-01097 03F

PENSTOCKS
STRUCTURAL BEHAVIOR MEASUREMENTS FOR PENSTOCKS THROUGH CONCRETE DAMS HUNGRY HORSE AND CANION FERRY DAMS,
W68-01222 08A

PERCOLATING WATER
REAL PROPERTY - WATERS AND WATERCOURCES - LIABILITY FOR DAMAGE CAUSED BY OBSTRUCTION OF PERCOLATING WATERS.
W68-01334 04C

PERCOLATION
FILTRATION RATES OF GROUND WATERS,
W68-01136 02G

PERMEABILITY
MODIFICATION OF THE PERMEABILITY OF LOESS BY ELECTROLYTES,
W68-01098 02G

GRAIN SIZE DISTRIBUTION AND ITS EFFECT ON THE PERMEABILITY OF UNCONSOLIDATED SANDS,
W68-01175 02G

PERMITS
SOME CURRENT AND PROPOSED WATER-RIGHTS LEGISLATION IN THE EASTERN STATES,
W68-01347 06E

DIVERSION OF LAKE MICHIGAN WATERS,
W68-01380 05E

PERSISTENCE
FACTORS AFFECTING PERSISTENCE AND INACTIVATION OF DIQUAT AND PARAQUAT,
W68-01274 05B

PERSISTENCE OF DIQUAT, PARAQUAT, AND 2,4-DBEE WHEN USED FOR EURASIAN WATERMILFOIL CONTROL,
W68-01279 04A

PESTICIDE KINETICS
ADSORPTION CATALYZED CHEMICAL HYDROLYSIS OF ATRAZINE,
W68-01246 03F

PHYTOTOXICITY
ADSORPTION CATALYZED CHEMICAL HYDROLYSIS OF ATRAZINE,
W68-01246 03F

PIERS
SCOUR AND FILL IN ALLUVIAL CHANNELS WITH PARTICULAR REFERENCE TO BRIDGE SITES,
W68-01139 08A

PILOT PLANTS
WATER RESEARCH AND DEVELOPMENT.
W68-01323 03A

PIPELINES
SUBMARINE PIPELINES,
W68-01199 08A

DECISIONS RELATING TO DISTRIBUTION OF PUBLIC WATER SUPPLIES,
W68-01374 03D

PIPES
PERFORMANCE OF DUCTILE-IRON PIPE IN SOILS,
W68-01194 08G

RIGID PIPES IN SYMMETRICAL AND UNSYMMETRICAL TRENCHES,
W68-01207 08D

PLANNING
WATER IN WEST PAKISTAN,
W68-01054 06B

INTERIM APPRAISAL OF OKLAHOMA BASINS PROJECT, OKLAHOMA WATER--THE KEY TO OKLAHOMA'S FUTURE.
W68-01131 06B

WATER RESOURCES PLANNING IN THE SOUTHEASTERN UNITED STATES,
W68-01358 06E

PLANT GROWTH
RECLAMATION OF ANCIENT AGRICULTURAL SOILS IN WAHIDI, SOUTH ARABIA,
W68-01177 03C

PLASTICS
RAINFALL COLLECTION FOR DOMESTIC WATER SUPPLIES,
W68-01079 03F

PLAYA LAKES
ARTIFICIAL GROUNDWATER RECHARGE THROUGH WELLS,
W68-01084 04B

POLICY MATTERS
AN ECOSYSTEMS APPROACH TO PUBLIC LAND POLICY,
W68-01206 06G

POLITICAL ASPECTS
THE DYNAMICS OF PUBLIC ROLES IN THE SELECTION OF REVENUE SOURCES IN LOCAL WATER ADMINISTRATION,
W68-01061 06C

POLLUTION ABATEMENT
A STUDY IN THE ECONOMICS OF WATER QUALITY MANAGEMENT,
W68-01051 05G

WASTE PRODUCT USE HELPS PAPER INDUSTRY CONTROL POLLUTION,
W68-01255 05B

WAR AGAINST WATER POLLUTION GETS MORE LIVELY.
W68-01304 05G

TEN YEARS OF PROGRESS IN POLLUTION ABATEMENT.
W68-01321 05G

PORE WATER PRESSURES
THEORETICAL STUDIES OF CRATERING MECHANISMS AFFECTING THE STABILITY OF CRATERED SLOPES,
W68-01195 08D

POROUS MEDIA
DYNAMICALLY SIMILAR MOTION OF TWO MISCIBLE CONSTITUENTS IN POROUS MEDIUMS,
W68-01031 02G

ONSET OF THERMOHALINE CONVECTION IN A POROUS MEDIUM,
W68-01038 08B

NONSTEADY COMPRESSIBLE FLOW THROUGH ANISOTROPIC POROUS MEDIUMS WITH PARTICULAR REFERENCE TO SNOW,
W68-01128 02C

DISPERSION IN LAYERED POROUS MEDIA,
W68-01178 08D

NONSTEADY-STATE FLOW IN PHREATIC AQUIFERS,
W68-01227 02F

CHARACTERISTICS OF INTERFACE FLOW IN SUBSURFACE DISPOSAL SYSTEMS,
W68-01245 05G

POTHOLES
EVAPOTRANSPIRATION AND THE WATER BUDGET OF PRAIRIE POTHOLES IN NORTH DAKOTA,
W68-01043 02D

PRECIPITATION
RATES OF EROSION AND SOIL FORMATION (IN THE HUMID AND ARID SUBTROPICS OF THE USSR),
W68-01169 02J

PRECIPITATION(ATMOSPHERIC)
HYDROLOGIC AND CLIMATOLOGIC DATA, 1967, SALT LAKE COUNTY, UTAH,
W68-01135 02A

PRECIPITATION CLIMATOLOGY OF LAKE MICHIGAN BASIN,
W68-01254 02B

PREFERENCES(WATER RIGHTS)
CLASSES OF WATER AND CHARACTER OF WATER RIGHTS AND USES - SECTION 54 BENEFICIAL AND REASONABLE USES OF WATER,
W68-01293 06E

WATER LAW AND DECISION-MAKING A CRITIQUE,
W68-01400 06C

PRESSURE CONDUITS
STRUCTURAL BEHAVIOR MEASUREMENTS FOR PENSTOCKS THROUGH CONCRETE DAMS HUNGRY HORSE AND CANYON FERRY DAMS,
W68-01222 08A

PRESSURE GAGES
THE EFFECT OF PLACEMENT METHOD ON THE RESPONSE OF SOIL STRESS GAGES,
W68-01202 08D

ROCK MECHANICS INSTRUMENTATION IN TUNNELS,
W68-01241 07B

PRESSURE SENSORS
ROCK MECHANICS INSTRUMENTATION IN TUNNELS,
W68-01241 07B

PRICES
ECONOMICS IN WATER RESEARCH,
W68-01115 06B

PRIOR APPROPRIATION
THE EFFECTS OF VARYING LAND AND WATER USE ON STREAMFLOW REGIMEN,
W68-01261 04C

BACKGROUND AND MODERN DEVELOPMENTS IN STATE WATER - RIGHTS LAW,
W68-01287 06E

CLASSES OF WATER AND CHARACTER OF WATER RIGHTS AND USES - SECTION 51 WATER-LAW DOCTRINE,
W68-01290 06E

CLASSES OF WATER AND CHARACTER OF WATER RIGHTS AND USES - SECTION 53 NATURE OF PROPERTY RIGHTS IN WATER,
W68-01292 06E

SOME CURRENT AND PROPOSED WATER-RIGHTS LEGISLATION IN THE EASTERN STATES,
W68-01347 06E

MISSISSIPPI WATER-USE LAWS AND ADMINISTRATION,
W68-01351 06E

SOME ECONOMIC ISSUES IN WATER RIGHTS,
W68-01382 06D

WATER RIGHTS LAW IN KENTUCKY - ALTERNATIVE LEGAL APPROACHES.
W68-01389 06E

WATER LAW AND PRIVATE DECISION-MAKING A CRITIQUE,
W68-01397 06D

AMERICAN WATER RIGHTS LAW,
W68-01398 06E

PROBABILITY
AVERAGE PROBABILITY OF EXTREME EVENTS,
W68-01059 06F

PROBABILISTIC MODELS FOR PREDICTING STREAM QUALITY,
W68-01149 05F

PROGLACIAL LAKE ENVIRONMENT
DEVELOPMENT, LANDFORMS AND CHRONOLOGY OF GENERATOR LAKE, BAFFIN ISLAND, N W T,
W68-01035 02C

PROJECT PLANNING
INCOME REDISTRIBUTION EFFECTS AND BENEFIT-COST ANALYSIS,
W68-01050 06C

THE COLUMBIA RIVER TREATY,
W68-01064 06E

SOME PHYSICAL, TECHNOLOGICAL, AND ECONOMIC CHARACTERISTICS OF WATER AND WATER RESOURCES SYSTEMS IMPLICATIONS FOR ADMINISTRATION,
W68-01341 06B

PROPERTY VALUES

TAX PROBLEMS RELATING TO WATER RIGHTS AND WATERWORKS - DIV A AND DIV B INTRODUCTION AND PROPERTY TAX,
W68-01296 06E

PUBLIC LAND
AN ECOSYSTEMS APPROACH TO PUBLIC LAND POLICY,
W68-01206 06G

PUBLIC RIGHTS
PUBLIC RIGHTS IN WATER USES AND PRIVATE RIGHTS IN LAND ADJACENT TO WATER - DIV A TRADITIONAL RIGHTS OF THE PUBLIC IN WATER USES,
W68-01288 06E

A FOUR STATE COMPARATIVE ANALYSIS OF PUBLIC RIGHTS IN WATER,
W68-01310 06B

THE STATE V THE RIPARIAN A PROBLEM OF WATER USE AND CONTROL.
W68-01333 06E

PUBLIC UTILITIES
THE HIERARCHY OF WATER QUALITY,
W68-01257 03D

PUERTO RICO
FLOODS IN THE MAYAGUEZ AREA OF PUERTIO RICO,
W68-01272 03B

PULP WASTES
WASTE PRODUCT USE HELPS PAPER INDUSTRY CONTROL POLLUTION,
W68-01255 05B

PUMP TURBINES
UNIDIRECTIONAL REVERSE HONE SYSTEM PUMP TURBINE,
W68-01225 08C

RADAR
THE ADJUSTMENT OF RADAR ESTIMATES OF STORM MEAN RAINFALL WITH RAIN GAGE DATA,
W68-01180 02B

RAIN GAGES
THE ADJUSTMENT OF RADAR ESTIMATES OF STORM MEAN RAINFALL WITH RAIN GAGE DATA,
W68-01180 02B

RAINDROPS
SOURCES OF ERROR IN CALCULATING THE KINETIC ENERGY OF RAINFALL,
W68-01089 02B

RAINFALL
SPECIES TRIALS IN THE SEMI-ARID SOUTHWEST OF NEW SOUTH WALES PART I--GRASSES AND LEGUMES,
W68-01074 03F

EDAPHIC RANGE AND COHABITATION OF SOME MALLEE EUCALYPTS IN SOUTH-EASTERN AUSTRALIA,
W68-01078 02I

RAINFALL COLLECTION FOR DOMESTIC WATER SUPPLIES,
W68-01079 03F

SOURCES OF ERROR IN CALCULATING THE KINETIC ENERGY OF RAINFALL,
W68-01089 02B

A STATISTICAL INVESTIGATION OF PERSISTENCE IN THE ISRAELI ARTIFICIAL RAINFALL STIMULATION EXPERIMENT,
W68-01094 03B

THE ADJUSTMENT OF RADAR ESTIMATES OF STORM MEAN RAINFALL WITH RAIN GAGE DATA,
W68-01180 02B

REAL PROPERTY
CLASSES OF WATER AND CHARACTER OF WATER RIGHTS AND USES - SECTION 53 NATURE OF PROPERTY RIGHTS IN WATER,
W68-01292 06E

REASONABLE USE
CLASSES OF WATER AND CHARACTER OF WATER RIGHTS AND USES - SECTION 54 BENEFICIAL AND REASONABLE USES OF WATER,
W68-01293 06E

LIABILITY FOR DIVERSION OF SURFACE WATERS.
W68-01330 04C

A SHORT COURSE ON WATER LAW FOR THE EASTERN UNITED STATES,
W68-01368 06E

THE DEVELOPMENT OF RIPARIAN LAW IN ALABAMA,
W68-01401 06E

RECHARGE WELLS
ARTIFICIAL GROUNDWATER RECHARGE THROUGH WELLS,
W68-01084 04B

RECREATION
PUBLIC RIGHTS IN INDIANA WATERS,
W68-01337 06E

RECREATION DEMAND
COMPARISONS OF METHODS FOR RECREATION EVALUATION,
W68-01063 06B

WATER-ORIENTED OUTDOOR RECREATION,
W68-01112 06D

REFORESTATION
PROTECTING OUR WATER RESOURCES,
W68-01345 03F

REFRACTION
REFRACTION DETERMINATION OF WATER TABLE DEPTH AND ALLUVIUM THICKNESS,
W68-01209 02F

REGIONS
THE CURRENT FEDERAL PROGRAM FOR RIVER BASIN PLANNING AND THE NEED FOR ECONOMIC ANALYSIS,
W68-01113 06B

REGRESSION ANALYSIS
WATER-ORIENTED OUTDOOR RECREATION,
W68-01112 06D

REGULATION
WATER LAW AND DECISION-MAKING A CRITIQUE,
W68-01400 06C

RELATIVE RIGHTS
A FOUR STATE COMPARATIVE ANALYSIS OF PUBLIC RIGHTS IN WATER,
W68-01310 06B

TRANSFER OF RIPARIAN RIGHT TO USE WATER TO NONRIPARIAN LAND.
W68-01372 06E

RIGHTS AND DUTIES OF OWNERS INTER SE WITH RESPECT TO UPKEEP AND REPAIR OF WATER EASEMENT,
W68-01375 06E

REMEDIES
URBAN DRAINAGE ASPECTS OF PUBLIC AND PRIVATE LIABILITY,
W68-01335 04C

A SHORT COURSE ON WATER LAW FOR THE EASTERN UNITED STATES,
W68-01368 06E

REPULSION(LEGAL ASPECTS)
LIABILITY FOR DIVERSION OF SURFACE WATERS.
W68-01330 04C

HIGHWAYS - FLOOD DAMAGE - PROPOSED MODIFICATION OF COMMON ENEMY RULE,
W68-01339 04C

RESEARCH AND DEVELOPMENT
EXAMPLES OF RECENT ADVANCES IN ANALYTICAL TECHNIQUES FOR EVALUATING AQUIFERS,
W68-01118 07A

UNIDIRECTIONAL REVERSE HONE SYSTEM PUMP TURBINE,
W68-01225 08C

RESERVATION DOCTRINE
(THE FEDERAL PROPRIETARY POWER IN WATER RIGHTS).
W68-01300 06E

RESERVOIR DESIGN
A PROBLEM OF OPTIMIZING A COLLECTING RESERVOIR SYSTEM,
W68-01151 08A

RESERVOIR OPERATION
LINEAR DYNAMIC DECOMPOSITION PROGRAMMING APPROACH TO LONG-RANGE OPTIMIZATION OF NORTHERN CALIFORNIA WATER RESOURCES SYSTEM, PART I DETERMINISTIC HYDROLOGY,
W68-01152 06A

COMPUTER MODELS FOR RESERVOIR REGULATION,
W68-01154 06A

RESERVOIR STORAGE
WATER SUPPLY ACT OF 1958.
W68-01342 06E

RESERVOIRS
FILL A LAKE, START AN EARTHQUAKE,
W68-01220 08E

RETENTION
PROTECTING OUR WATER RESOURCES,
W68-01345 03F

REVIEWS
REVIEW OF THE METABOLISM AND DECOMPOSITION OF DIQUAT AND PARAQUAT,
W68-01275 05A

RIPARIAN DOCTRINE
WATER LAW AND PRIVATE DECISION-MAKING A CRITIQUE,
W68-01397 06D

RIPARIAN LAND
REAL PROPERTY - RIPARIAN RIGHTS,
W68-01381 06E

RIPARIAN RIGHTS
BACKGROUND AND MODERN DEVELOPMENTS IN STATE WATER - RIGHTS LAW,
W68-01287 06E

CLASSES OF WATER AND CHARACTER OF WATER RIGHTS AND USES - SECTION 51 WATER-LAW DOCTRINE,
W68-01290 06E

CLASSES OF WATER AND CHARACTER OF WATER RIGHTS AND USES - SECTION 53 NATURE OF PROPERTY RIGHTS IN WATER,
W68-01292 06E

PRIVATE WATER RIGHTS IN FRANCE AND IN THE EASTERN UNITED

TATES,
68-01320 06E

RIPARIAN RIGHTS - INLAND WATERS - RIGHT OF AN OWNER OF LAND BUTTING ON INTER-TRACT LAKE TO THE USE OF THE ENTIRE SURFACE,
W68-01328 06E

NAVIGABLE WATERS - RIGHTS OF RIPARIAN OWNER HELD NOT TO INCLUDE THE RIGHT TO CONSTRUCT A PERMANENT DEEP WATER DOCK INTO LAKE HURON,
W68-01329 04C

PUBLIC RIGHTS IN INDIANA WATERS,
W68-01337 06E

STATUTES FOR ADMINISTERING WATER USE IN THE SOUTHEAST,
W68-01350 06E

THE ADMINISTRATION OF WATER LAWS IN FLORIDA,
W68-01356 06C

EASTERN LAWS CONCERNING MINIMUM STREAM FLOWS AND IMPOUNDMENTS,
W68-01357 06E

TRANSFER OF RIPARIAN RIGHT TO USE WATER TO NONRIPARIAN LAND.
W68-01372 06E

AGREEMENT IN RESPECT OF WATER RIGHTS IN STREAM AS CREATING A MERE PERSONAL OBLIGATION, COVENANT RUNNING WITH THE LAND, OR AN EASEMENT.
W68-01373 06E

REAL PROPERTY - RIPARIAN RIGHTS,
W68-01381 06E

SOME ECONOMIC ISSUES IN WATER RIGHTS,
W68-01382 06D

WATER RIGHTS LAW IN KENTUCKY.
W68-01385 06E

WATER RIGHTS LAW IN KENTUCKY -- HISTORICAL DEVELOPMENT OF KENTUCKY WATER LAW.
W68-01386 06E

WATER RIGHTS LAW IN KENTUCKY - ALTERNATIVE LEGAL APPROACHES.
W68-01389 06E

THE RIGHTS OF A RIPARIAN LANDOWNER IN MISSOURI,
W68-01390 06E

AMERICAN WATER RIGHTS LAW,
W68-01398 06E

THE DEVELOPMENT OF RIPARIAN LAW IN ALABAMA,
W68-01401 06E

GEORGIA WATER LAW, USE AND CONTROL FACTORS,
W68-01402 06D

IVER BASIN COMMISSIONS
WATER RESOURCES PLANNING.
W68-01307 06B

IVER BASIN DEVELOPMENT
MATHEMATICAL MODELS THE MULTISTRUCTURE APPROACH TWO SEASONS, PREDICTABLE HYDROLOGY,
W68-01153 06A

MATHEMATICAL MODELS THE MULTISTRUCTURE APPROACH ALLOWANCE FOR UNCERTAINTY,
W68-01166 06A

IVER BASINS
LINEAR DYNAMIC DECOMPOSITION PROGRAMMING APPROACH TO LONG-RANGE OPTIMIZATION OF NORTHERN CALIFORNIA WATER RESOURCES SYSTEM, PART I DETERMINISTIC HYDROLOGY,
W68-01152 06A

ELECTRONIC ANALOG MODELING AS AN AID IN WATER RESOURCE INVESTIGATIONS,
W68-01232 03B

IVER FLOW
FLUVIAL PROCESSES IN THE HIGH ARCTIC,
W68-01029 02C

EFFECTIVENESS OF HERBICIDAL COMBINATIONS ON ALLIGATORWEED GROWING IN FLOWING WATER,
W68-01280 04A

IVERS AND HARBORS ACT
RED RIVER BELOW DENISON DAM, LOUISIANA, ARKANSAS, OKLAHOMA AND TEXAS.
W68-01032 06B

OAD CONSTRUCTION
HIGHWAYS - FLOOD DAMAGE - PROPOSED MODIFICATION OF COMMON ENEMY RULE,
W68-01339 04C

OCK BOLTS
ROD REINFORCEMENT OF TUNNEL TYPE EXCAVATIONS,
W68-01201 08A

OCK MECHANICS
ROD REINFORCEMENT OF TUNNEL TYPE EXCAVATIONS,
W68-01201 08A

ROCK MECHANICS INSTRUMENTATION IN TUNNELS,
W68-01241 07B

ROCKFILL DAMS
CRIB DAMS FOR CONTROL OF SEDIMENT AND STREAMBED EROSION AND THEIR SUITABILITY FOR CONDITIONS IN PAKISTAN,
W68-01179 08D

RODENTS
PERUVIAN DESERT MICE WATER INDEPENDENCE, COMPETITION, AND BREEDING CYCLE NEAR THE EQUATOR,
W68-01081 02I

ROOT SYSTEMS
XEROPHYTIC STRUCTURES IN THE ROOTS OF DESERT SHRUBS,
W68-01170 02I

ROUGHNESS(HYDRAULIC)
SOME STUDIES ON NEW TYPES OF FRICTION BLOCKS,
W68-01258 08B

VARIATIONS OF THE HYDRAULIC ROUGHNESS OF ALLUVIAL CHANNELS,
W68-01273 08B

RUNOFF
FLUVIAL PROCESSES IN THE HIGH ARCTIC,
W68-01029 02C

HYDROLOGY OF THE LEWIS GLACIER, NORTH-CENTRAL BAFFIN ISLAND, N W T, AND DISCUSSION OF RELIABILITY OF THE MEASUREMENTS.
W68-01041 02C

SPRING SLOPE RUNOFF FROM THE PRINCIPAL AGRICULTURAL LANDS OF THE KULUNDA STEPPE,
W68-01174 02C

SALINE
UNUSUAL MONOMIXIS IN TWO SALINE ARIZONA PONDS,
W68-01095 03C

SALINE LAKES
CHEMICAL AND BIOLOGICAL STUDIES ON SOME SALINE LAKES OF SOUTH-EAST AUSTRALIA,
W68-01082 02H

SALINE SOILS
FRESH AND SALINE GROUND-WATER ZONES IN THE PUNJAB REGION, WEST PAKISTAN,
W68-01039 03C

EFFECT OF SOIL SALINITY ON WATER POTENTIALS AND TRANSPIRATION IN PEPPER (CAPSICUM FRUTESCENS),
W68-01072 03F

SPECIES TRIALS IN THE SEMI-ARID SOUTHWEST OF NEW SOUTH WALES PART II--NATIVE SHRUB TRIALS IN THE HAY DISTRICT,
W68-01075 03F

LANDFORMING FOR LEACHING OF SALINE SOILS IN A NONIRRIGATED AREA,
W68-01087 03F

RESEARCH ON ELECTRORECLAMATION OF SALINE-ALKALI SOILS,
W68-01108 02K

SPRING SLOPE RUNOFF FROM THE PRINCIPAL AGRICULTURAL LANDS OF THE KULUNDA STEPPE,
W68-01174 02C

SALINE WATER
FRESH AND SALINE GROUND-WATER ZONES IN THE PUNJAB REGION, WEST PAKISTAN,
W68-01039 03C

DISSOLVED-MINERAL INFLOW TO GREAT SALT LAKE AND CHEMICAL CHARACTERISTICS OF THE SALT LAKE BRINE SUMMARY FOR WATER YEARS 1960, 1961, AND 1964,
W68-01249 02E

SALINE WATER SYSTEMS
FRESH AND SALINE GROUND-WATER ZONES IN THE PUNJAB REGION, WEST PAKISTAN,
W68-01039 03C

DISSOLVED-MINERAL INFLOW TO GREAT SALT LAKE AND CHEMICAL CHARACTERISTICS OF THE SALT LAKE BRINE SUMMARY FOR WATER YEARS 1960, 1961, AND 1964,
W68-01249 02E

SALINITY
INDUS RIVER BASIN STUDIES.
W68-01148 03C

DEPTH OF DRAINAGE IN IRRIGATED AREAS,
W68-01231 04A

SALT MARSHES
RESISTANCE OF TEXAS SALT - AND FRESHWATER - MARSH FISHES TO HEAT DEATH AT VARIOUS SALINITIES,
W68-01073 05C

SALT TOLERANCE
GEOGRAPHIC DISTRIBUTION AND FACTORS AFFECTING THE DISTRIBUTION OF SALT DESERT SHRUBS IN THE UNITED STATES,
W68-01176 02I

SANDS
GRAIN SIZE DISTRIBUTION AND ITS EFFECT ON THE PERMEABILITY OF UNCONSOLIDATED SANDS,
W68-01175 02G

SANITARY ENGINEERING
WATER CONSERVATION BY RECLAMATION AND RECHARGE,
W68-01048 05D

THE HIERARCHY OF WATER QUALITY,
W68-01257 03D

SATURATED SOILS
FRESH AND SALINE GROUND-WATER ZONES IN THE PUNJAB REGION, WEST PAKISTAN,
W68-01039 03C

SCOUR
SCOUR AND FILL IN ALLUVIAL CHANNELS WITH PARTICULAR REFERENCE TO BRIDGE SITES,
W68-01139 08A

WAVE PROPAGATION AND BOUNDARY INSTABILITY IN ERODIBLE-BED CHANNELS,
W68-01236 08B

SEASONAL
MATHEMATICAL MODELS THE MULTISTRUCTURE APPROACH MORE PERIODS, PREDICTABLE HYDROLOGY,
W68-01163 06A

SEDIMENT CONTROL
CRIB DAMS FOR CONTROL OF SEDIMENT AND STREAMBED EROSION AND THEIR SUITABILITY FOR CONDITIONS IN PAKISTAN,
W68-01179 08D

SEDIMENT TRANSPORT
DISPERSION OF MASS IN OPEN-CHANNEL FLOW,
W68-01129 08B

SAND DISPERSION IN A LABORATORY FLUME,
W68-01247 02J

SEDIMENTATION RATES
SEDIMENTATION IN ONSLOW BAY (IN GUIDEBOOK FOR FIELD EXCURSIONS, GEOLOGICAL SOCIETY OF AMERICA, SOUTHEASTERN SECTION),
W68-01262 02L

SUSPENDED SEDIMENT OF THE NORTHERN CHESAPEAKE BAY,
W68-01268 02L

SEDIMENTS
EFFECTS OF SURFACE SEDIMENTS ON GROUNDWATER RECHARGE,
W68-01085 04B

SEEPAGE
DIFFERENCES BETWEEN EUROPEAN AND AMERICAN PRACTICE IN THE USE OF GROUT CURTAINS IN ROCK FOUNDATIONS,
W68-01210 08E

GROUNDWATER SEEPAGE RATES,
W68-01237 02F

SEISMIC DESIGN
THE TASHKENT EARTHQUAKE,
W68-01205 08E

STABILITY OF DAMS ERECTED OF LOCAL MATERIALS UNDER DYNAMIC LOADS,
W68-01208 08D

SEISMIC INVESTIGATIONS
REFRACTION DETERMINATION OF WATER TABLE DEPTH AND ALLUVIUM THICKNESS,
W68-01209 02F

APPLICATION OF SEISMIC EXPLORATION METHODS IN ENGINEERING-GEOLOGICAL INVESTIGATIONS,
W68-01223 08E

SEPTIC TANKS
CHARACTERISTICS OF INTERFACE FLOW IN SUBSURFACE DISPOSAL SYSTEMS,
W68-01245 05G

SETTLEMENT(STRUCTURAL)
LAND SUBSIDENCE ALONG THE DELTA-MENDOTA CANAL, CALIFORNIA,
W68-01127 08A

SEWAGE TREATMENT
HOW TO OPERATE 'PACKAGE' WASTEWATER TREATMENT PLANTS,
W68-01020 05D

PILOT PLANT STUDIES ON THE ANAEROBIC TREATMENT OF TANNERY EFFLUENTS,
W68-01125 05D

PROBABILISTIC MODELS FOR PREDICTING STREAM QUALITY,
W68-01149 05F

SHAFTS(MINING)
BIG-HOLE DRILLING IS COMING OF AGE UNDERGROUND,
W68-01196 08H

SHEET PILING
ANALYSIS OF THE STABILITY OF COFFERDAMS WITH DOUBLE SHEET WALLS ACCORDING TO FIELD AND MODEL TESTS,
W68-01228 08A

SHORES
PUBLIC RIGHTS IN WATER USES AND PRIVATE RIGHTS IN LAND ADJACENT TO WATER - DIVISION B PRIVATE RIGHTS IN LAND ADJACENT TO WATER,
W68-01289 06E

SHRUBS
SPECIES TRIALS IN THE SEMI-ARID SOUTHWEST OF NEW SOUTH WALE PART II--NATIVE SHRUB TRIALS IN THE HAY DISTRICT,
W68-01075 03F

XEROPHYTIC STRUCTURES IN THE ROOTS OF DESERT SHRUBS,
W68-01170 02I

SIMULATION ANALYSIS
USE OF MODERN EQUIPMENT AND TECHNIQUES IN THE PLANNING AND DEVELOPMENT OF WATER RESOURCES,
W68-01160 06A

SLUDGE DIGESTION
PILOT PLANT STUDIES ON THE ANAEROBIC TREATMENT OF TANNERY EFFLUENTS,
W68-01125 05D

SNOW
NONSTEADY COMPRESSIBLE FLOW THROUGH ANISOTROPIC POROUS MEDIUMS WITH PARTICULAR REFERENCE TO SNOW,
W68-01128 02C

SNOWMELT
FLUVIAL PROCESSES IN THE HIGH ARCTIC,
W68-01029 02C

HYDROLOGY OF THE LEWIS GLACIER, NORTH-CENTRAL BAFFIN ISLAND N W T, AND DISCUSSION OF RELIABILITY OF THE MEASUREMENTS.
W68-01041 02C

SOCIAL VALUES
THE ANIMAL FARM A MATHEMATICAL MODEL FOR THE DISCUSSION OF SOCIAL STANDARDS FOR CONTROL OF THE ENVIRONMENT,
W68-01157 06B

SODIUM CHLORIDE
BULK VOLUME AND HYDRAULIC CONDUCTIVITY CHANGES DURING SODIUM SATURATION TESTS,
W68-01070 02G

SOIL DISPOSAL FIELDS
CHARACTERISTICS OF INTERFACE FLOW IN SUBSURFACE DISPOSAL SYSTEMS,
W68-01245 05G

SOIL FORMATION
RATES OF EROSION AND SOIL FORMATION (IN THE HUMID AND ARID SUBTROPICS OF THE USSR),
W68-01169 02J

SOIL MANAGEMENT
INTEGRATING FARM AND WATERSHED PLANNING IN SOIL AND WATER RESOURCE MANAGEMENT,
W68-01234 03F

SOIL MOISTURE
DYNAMICALLY SIMILAR MOTION OF TWO MISCIBLE CONSTITUENTS IN POROUS MEDIUMS,
W68-01031 02G

TIME OF FERTILIZER APPLICATION ON DESERT GRASSLANDS,
W68-01068 03F

STUDIES OF THE DRYING OF BARE GROUND,
W68-01076 02D

SPRING SLOPE RUNOFF FROM THE PRINCIPAL AGRICULTURAL LANDS OF THE KULUNDA STEPPE,
W68-01174 02C

GEOGRAPHIC DISTRIBUTION AND FACTORS AFFECTING THE DISTRIBUTION OF SALT DESERT SHRUBS IN THE UNITED STATES,
W68-01176 02I

EFFECTS OF TEMPERATURE AND PRESSURE ON UNFROZEN SOIL WATER,
W68-01264 02C

SOIL TEXTURE
EDAPHIC RANGE AND COHABITATION OF SOME MALLEE EUCALYPTS IN SOUTH-EASTERN AUSTRALIA,
W68-01078 02I

SOILS CHEMISTRY
PHYSICAL-CHEMICAL PROPERTIES OF NATURALLY OCCURRING POLYELECTROLYTES--(PART) 1, SODIUM HUMATE,
W68-01253 02K

SOLIDS CONTACT PROCESS
PILOT PLANT STUDIES ON THE ANAEROBIC TREATMENT OF TANNERY EFFLUENTS,
W68-01125 05D

SOUTHEAST U S
WATER RESOURCES PLANNING IN THE SOUTHEASTERN UNITED STATES,
W68-01358 06E

SOUTHEAST US
WATER LAW AND POLICY IN THE SOUTHEAST.
W68-01348 06E

COMMON LAW RULES REGARDING THE USE OF SURFACE AND GROUND WATER IN THE SOUTHEASTERN STATES,
W68-01349 06E

SPECIFIC YIELD
IDENTIFICATION OF AQUIFER PARAMETERS BY DECOMPOSITION AND MULTILEVEL OPTIMIZATION,
W68-01047 02F

SPECTROMETERS

A FLEXIBLE COMPUTER PROGRAM FOR EVALUATION OF EMISSION SPECTROMETRIC DATA,
W68-01252 07C

SPILLWAYS
DESIGNING THE APPROACH CHANNEL FOR SHAFT SPILLWAYS,
W68-01226 08B

SPRINKLER IRRIGATION
FACTORS AFFECTING THE EMERGENCE OF SUGAR BEETS IN AN IRRIGATED DESERT ENVIRONMENT,
W68-01187 03F

OVERHEAD IRRIGATION ENCOURAGES WET-WEATHER PLANT DISEASES,
W68-01192 03F

STAGE-DISCHARGE RELATIONS
SUBCRITICAL FLOW OVER HIGHWAY EMBANKMENTS,
W68-01022 08B

MAGNITUDE AND FREQUENCY OF FLOODS IN THE UNITED STATES PART 5. HUDSON BAY AND UPPER MISSISSIPPI RIVER BASIN,
W68-01023 02E

ANALYSIS OF SUBMERGENCE IN FLOW MEASURING FLUMES,
W68-01123 08B

FLOODS IN THE MAYAGUEZ AREA OF PUERTIO RICO,
W68-01272 03B

STANDARDS
A STUDY IN THE ECONOMICS OF WATER QUALITY MANAGEMENT,
W68-01165 05G

HEARINGS ON S4 BEFORE A SPECIAL SUBCOMMITTEE ON AIR AND WATER POLLUTION OF THE COMMITTEE ON PUBLIC WORKS, UNITED STATES SENATE.
W68-01369 05G

W68-01370 05G

STATE GOVERNMENTS
BACKGROUND AND MODERN DEVELOPMENTS IN STATE WATER - RIGHTS LAW,
W68-01287 06E

REGULATION OF WATER USE IN LOCAL AREAS BY STATE OR LOCAL GOVERNMENTS AND DISTRICTS,
W68-01355 06E

STATISTICAL METHODS
CONDITIONAL PROBABILITY OF OCCURRENCE FOR VARIATIONS IN CLIMATE BASED ON WIDTHS OF ANNUAL TREE RINGS IN ARIZONA,
W68-01251 02B

STATISTICAL MODELS
OPTIMAL POLICY FOR HYDROELECTRIC OPERATIONS,
W68-01150 08C

A PROBLEM OF OPTIMIZING A COLLECTING RESERVOIR SYSTEM,
W68-01151 08A

STILLING BASINS
SOME STUDIES ON NEW TYPES OF FRICTION BLOCKS,
W68-01258 08B

STOCHASTIC PROCESSES
PROBABILISTIC MODELS FOR PREDICTING STREAM QUALITY,
W68-01149 05F

SAND DISPERSION IN A LABORATORY FLUME,
W68-01247 02J

STOMATA
EFFECT OF SOIL MOISTURE DEPLETION ON CROP YIELD AND STOMATAL INFILTRATION,
W68-01189 03F

STORAGE COEFFICIENT
IDENTIFICATION OF AQUIFER PARAMETERS BY DECOMPOSITION AND MULTILEVEL OPTIMIZATION,
W68-01047 02F

STORM RUNOFF
HYDROGRAPHS OF EPHEMERAL STREAMS IN THE SOUTHWEST,
W68-01092 04A

FLOOD OF MARCH 24, 1967, KIHEI AND OLOWALU AREAS, ISLAND OF MAUI, HAWAII,
W68-01133 02E

STORMS
PRECIPITATION CLIMATOLOGY OF LAKE MICHIGAN BASIN,
W68-01254 02B

STREAM EROSION
WAVE PROPAGATION AND BOUNDARY INSTABILITY IN ERODIBLE-BED CHANNELS,
W68-01236 08B

STREAM GAGES
GENERAL PROCEDURE FOR GAGING STREAMS,
W68-01138 07A

STREAMBEDS
WAVE PROPAGATION AND BOUNDARY INSTABILITY IN ERODIBLE-BED CHANNELS,
W68-01236 08B

STREAMFLOW
STREAMS IN DUTCHESS COUNTY, NEW YORK--THEIR FLOW CHARACTERISTICS AND WATER QUALITY IN RELATION TO WATER PROBLEMS,
W68-01042 04A

STREAMFLOW FLUCTUATION, BAR ROUGHNESS, AND BED LOAD MOVEMENT A HYPOTHESIS,
W68-01044 02E

HYDROLOGICAL YEAR-BOOK OF ISRAEL 1965/66.
W68-01119 02A

HYDROLOGIC AND CLIMATOLOGIC DATA, 1967, SALT LAKE COUNTY, UTAH,
W68-01135 02A

ELECTRONIC ANALOG MODELING AS AN AID IN WATER RESOURCE INVESTIGATIONS,
W68-01232 03B

DISSOLVED-MINERAL INFLOW TO GREAT SALT LAKE AND CHEMICAL CHARACTERISTICS OF THE SALT LAKE BRINE SUMMARY FOR WATER YEARS 1960, 1961, AND 1964,
W68-01249 02E

STREAMFLOW FORECASTING
MAGNITUDE AND FREQUENCY OF FLOODS IN THE UNITED STATES PART 5. HUDSON BAY AND UPPER MISSISSIPPI RIVER BASIN,
W68-01023 02E

STRUCTURAL BEHAVIOR
STRUCTURAL BEHAVIOR MEASUREMENTS FOR PENSTOCKS THROUGH CONCRETE DAMS HUNGRY HORSE AND CANYON FERRY DAMS,
W68-01222 08A

STRUCTURAL DESIGN
NEW DISTRIBUTIONS OF EXTREME WINDS IN THE UNITED STATES,
W68-01200 07A

SUBCRITICAL FLOW
SUBCRITICAL FLOW OVER HIGHWAY EMBANKMENTS,
W68-01022 08B

ANALYSIS OF SUBMERGENCE IN FLOW MEASURING FLUMES,
W68-01123 08B

SUBMERGED LANDS ACT
BOUNDARY PROBLEMS RAISED BY THE SUBMERGED LANDS ACT,
W68-01394 06E

SUBMERGENCE
SUBMARINE PIPELINES,
W68-01199 08A

SUBSURFACE DRAINAGE
REAL PROPERTY - WATERS AND WATERCOURCES - LIABILITY FOR DAMAGE CAUSED BY OBSTRUCTION OF PERCOLATING WATERS.
W68-01334 04C

IMPLIED COVENANT TO PROTECT LEASED PREMISES FROM DRAINAGE WHERE LESSEE IS RESPONSIBLE FOR DRAINAGE,
W68-01336 04C

SUBSURFACE DRAINS
DEPTH OF DRAINAGE IN IRRIGATED AREAS,
W68-01231 04A

SUGAR BEETS
PREHARVEST WATER STRESS FOR VALLEY SUGAR BEETS,
W68-01101 03F

FACTORS AFFECTING THE EMERGENCE OF SUGAR BEETS IN AN IRRIGATED DESERT ENVIRONMENT,
W68-01187 03F

SUGARCANE
SUGAR CANE IRRIGATION A CASE STUDY IN CAPITAL BUDGETING,
W68-01164 03F

SULFITE LIQUORS
WASTE PRODUCT USE HELPS PAPER INDUSTRY CONTROL POLLUTION,
W68-01255 05B

SURFACE DRAINAGE
URBAN DRAINAGE ASPECTS OF PUBLIC AND PRIVATE LIABILITY,
W68-01335 04C

SURFACE IRRIGATION
INDUS RIVER BASIN STUDIES.
W68-01148 03C

SURFACE RUNOFF
FIELD AND LABORATORY EXPERIMENTAL APPROACHES,
W68-01233 02E

HIGHWAYS - FLOOD DAMAGE - PROPOSED MODIFICATION OF COMMON ENEMY RULE,
W68-01339 04C

REAL PROPERTY - SURFACE WATERS - COMMON ENEMY RULE AMPLIFIED,
W68-01391 06E

SURFACE WATERS
STREAMS IN DUTCHESS COUNTY, NEW YORK--THEIR FLOW CHARACTERISTICS AND WATER QUALITY IN RELATION TO WATER PROBLEMS,
W68-01042 04A

MINERALS AND WATER, BUTLER COUNTY, ALABAMA.
W68-01137 03B

WATER RESOURCES OF THE SALISBURY AREA, MARYLAND,
W68-01141 03B

SELECTED HYDROLOGIC DATA, SAN PITCH RIVER DRAINAGE BASIN, UTAH,
W68-01146 03B

INTEGRATING MANAGEMENT OF GROUND AND IMPORTED WATER IN LOS ANGELES COUNTY,
W68-01193 03D

HYDROLOGIC DATA 1966 VOLUME 3--CENTRAL COASTAL AREA, APPENDICES A-E.
W68-01259 02A

HYDROLOGIC DATA 1966 VOLUME V--SOUTHERN CALIFORNIA, APPENDICES A-C.
W68-01260 02A

GEOLOGY AND WATER RESOURCES OF THE HIBBING AREA, NORTHEASTERN MINNESOTA,
W68-01267 04B

CLASSES OF WATER AND CHARACTER OF WATER RIGHTS AND USES - SECTION 52 THE PRINCIPAL CATEGORIES OF SURFACE AND GROUND WATERS,
W68-01291 06E

COMMON LAW RULES REGARDING THE USE OF SURFACE AND GROUND WATER IN THE SOUTHEASTERN STATES,
W68-01349 06E

GEORGIA WATER LAW, USE AND CONTROL FACTORS,
W68-01402 06D

SURFACE-GROUNDWATER RELATIONSHIPS
OPTIMIZING CONJUNCTIVE USE OF SURFACE WATER AND GROUNDWATER,
W68-01155 02A

SURVEYING
GEODIMETER FAULT MOVEMENT INVESTIGATIONS IN CALIFORNIA,
W68-01224 08E

SUSPENDED LOAD
SUSPENDED SEDIMENT OF THE NORTHERN CHESAPEAKE BAY,
W68-01268 02L

SYNTHETIC HYDROLOGY
COMPUTER MODELS FOR RESERVOIR REGULATION,
W68-01154 06A

MATHEMATICAL MODELS THE MULTISTRUCTURE APPROACH ALLOWANCE FOR UNCERTAINTY,
W68-01166 06A

SYSTEMATICS
GEOGRAPHIC DISTRIBUTION AND FACTORS AFFECTING THE DISTRIBUTION OF SALT DESERT SHRUBS IN THE UNITED STATES,
W68-01176 02I

SYSTEMS ANALYSIS
USE OF SYSTEMS ANALYSIS IN ESTUARINE WATER POLLUTION CONTROL,
W68-01162 05G

TAXES

W68-01285 06E

TAX PROBLEMS RELATING TO WATER RIGHTS AND WATERWORKS - DIV A AND DIV B INTRODUCTION AND PROPERTY TAX,
W68-01296 06E

TAX PROBLEMS RELATING TO WATER RIGHTS AND WATERWORKS - DIV C SPECIAL TAXES ON WATER AND ELECTRIC COMPANIES - DIV D FEDERAL INCOME TAX PROBLEMS RELATING TO WATER RIGHTS AND H2O WKS,
W68-01297 06E

WAR AGAINST WATER POLLUTION GETS MORE LIVELY.
W68-01304 05G

TEMPERATURE
RATES OF EROSION AND SOIL FORMATION (IN THE HUMID AND ARID SUBTROPICS OF THE USSR),
W68-01169 02J

TEMPERATURE SENSORS
MEASURING INTERNAL TEMPERATURES IN MASS CONCRETE,
W68-01203 08G

TENNESSEE VALLEY AUTHORITY PROJECT
THE GREAT LAKES WATER RESOURCE,
W68-01305 05C

TERTIARY TREATMENT
HOW TO OPERATE 'PACKAGE' WASTEWATER TREATMENT PLANTS,
W68-01020 05D

WATER CONSERVATION BY RECLAMATION AND RECHARGE,
W68-01048 05D

TEST FACILITIES
RESULTS IN HVDC CONVERTOR TESTING AND UTILIZATION OF THE RHEINAU RESEARCH LABORATORY FACILITIES,
W68-01219 08C

TEST PROCEDURES
SELECTIVE ION ELECTRODE SYSTEM FOR FLUORIDE ANALYSIS,
W68-01116 07B

THERMAL EXPANSION
MEASURING INTERNAL TEMPERATURES IN MASS CONCRETE,
W68-01203 08G

THERMAL POLLUTION
ANALYZING STEAM ELECTRIC POWER PLANT DISCHARGES,
W68-01026 05B

THERMAL PROPERTIES
STUDIES OF THE DRYING OF BARE GROUND,
W68-01076 02D

EFFECTS OF TEMPERATURE AND PRESSURE ON UNFROZEN SOIL WATER,
W68-01264 02C

THERMODYNAMICS
ANALYZING STEAM ELECTRIC POWER PLANT DISCHARGES,
W68-01026 05B

TILE DRAINAGE
INSECTICIDES IN TILE DRAINAGE EFFLUENT,
W68-01191 05G

TILE DRAINS
DEPTH OF DRAINAGE IN IRRIGATED AREAS,
W68-01231 04A

TRACE ELEMENTS
DETERMINATION OF MOLYBDENUM IN FRESH WATERS - A COMPARISON OF METHODS,
W68-01046 02K

USE OF MERCUROUS CHLORIDE TO RECOVER TRACE AMOUNTS OF GOLD FROM WATERS,
W68-01124 02K

TRACERS
U S GEOLOGICAL SURVEY TRACER STUDY AMARGOSA DESERT, NYE COUNTY, NEVADA--PART I EXPLORATORY DRILLING, TRACER WELL CONSTRUCTION AND TESTING AND PRELIMINARY FINDINGS,
W68-01248 04B

TRANSISTORS
EXPERIENCE WITH TRANSISTORISED PROTECTION IN BRITAIN,
W68-01215 08C

TRANSMISSION LINES
TRANSIENT RECOVERY VOLTAGE CAUSED BY DIFFERENT SWITCHING OPERATIONS IN HV NETWORKS CONTAINING UNDERGROUND CABLES,
W68-01211 08C

STRESSES IN TRANSMISSION LINE CONDUCTORS NEAR THE SUSPENSION CLAMP,
W68-01213 08C

TRANSMISSION TOWERS
THE USE OF SOIL MECHANICS METHODS FOR ADAPTING TOWER FOUNDATIONS TO SOIL CONDITIONS,
W68-01212 08D

TRANSMISSION(ELECTRICAL)
A TECHNICAL AND ECONOMIC COMPARISON BETWEEN AC AND DC TRANSMISSION,
W68-01217 08C

TRANSMISSIVITY
IDENTIFICATION OF AQUIFER PARAMETERS BY DECOMPOSITION AND MULTILEVEL OPTIMIZATION,
W68-01047 02F

HYDROGRAPHS OF EPHEMERAL STREAMS IN THE SOUTHWEST,
W68-01092 04A

TRANSPIRATION
OBSERVATIONS ONMICROCLIMATE AND VEGETATION INTERRELATIONSHIPS ON THE ACCRA PLAINS (GHANA),
W68-01077 02D

TRANSPIRATION PATTERNS OF WHEAT, BARLEY AND OAT SEEDLINGS UNDER VARYING CONDITIONS OF SOIL MOISTURE,
W68-01190 03F

TRANSPIRATION CONTROL
SOME PHYSICAL ASPECTS OF INTERNAL CONTROL OF LEAF TRANSPIRATION,
W68-01109 02D

TRANSPORTATION
RED RIVER BELOW DENISON DAM, LOUISIANA, ARKANSAS, OKLAHOMA AND TEXAS.
W68-01032 06B

TREES
EDAPHIC RANGE AND COHABITATION OF SOME MALLEE EUCALYPTS IN SOUTH-EASTERN AUSTRALIA,
W68-01078 02I

TRENCHES
RIGID PIPES IN SYMMETRICAL AND UNSYMMETRICAL TRENCHES,
W68-01207 08D

TRIAXIAL SHEAR
LONG-TERM DEFORMATION IN CLAY,
W68-01198 08D

TUNNEL CONSTRUCTION
BIG-HOLE DRILLING IS COMING OF AGE UNDERGROUND,
W68-01196 08H

NEW AUSTRIAN TUNNEL CONSTRUCTION METHOD,
W68-01197 08H

TUNNEL DESIGN
ROD REINFORCEMENT OF TUNNEL TYPE EXCAVATIONS,
W68-01201 08A

TUNNEL LININGS
NEW AUSTRIAN TUNNEL CONSTRUCTION METHOD,
W68-01197 08H

TUNNEL PRESSURES
ROCK MECHANICS INSTRUMENTATION IN TUNNELS,
W68-01241 07B

TUNNELING
NEW AUSTRIAN TUNNEL CONSTRUCTION METHOD,
W68-01197 08H

TUNNELING MACHINES
BIG-HOLE DRILLING IS COMING OF AGE UNDERGROUND,
W68-01196 08H

TUNNELS
NEW AUSTRIAN TUNNEL CONSTRUCTION METHOD,
W68-01197 08H

ROCK MECHANICS INSTRUMENTATION IN TUNNELS,
W68-01241 07B

TURBINE RUNNERS
UNIDIRECTIONAL REVERSE HOME SYSTEM PUMP TURBINE,
W68-01225 08C

ULTRASONICS
ULTRASONIC METHOD OF FLOW MEASUREMENT,
W68-01240 07B

ULTRAVIOLET RADIATION
PHOTOCHEMICAL DECOMPOSITION OF DIQUAT AND PARAQUAT,
W68-01276 05A

UNAPPROPRIATED WATER
(THE FEDERAL PROPRIETARY POWER IN WATER RIGHTS).
W68-01300 06E

UNDERSEEPAGE
DIFFERENCES BETWEEN EUROPEAN AND AMERICAN PRACTICE IN THE USE OF GROUT CURTAINS IN ROCK FOUNDATIONS,
W68-01210 08E

UNDERWATER
SUBMARINE PIPELINES,
W68-01199 08A

UNITED STATES
THE COLUMBIA RIVER TREATY,
W68-01064 06E

UNSTEADY FLOW
NONSTEADY COMPRESSIBLE FLOW THROUGH ANISOTROPIC POROUS MEDIUMS WITH PARTICULAR REFERENCE TO SNOW,
W68-01128 02C

URBANIZATION
WATER DATA FOR METROPOLITAN AREAS,
W68-01027 07A

THE EFFECTS OF VARYING LAND AND WATER USE ON STREAMFLOW REGIMEN,
W68-01261 04C

VAPOR PRESSURE
SOME PHYSICAL ASPECTS OF INTERNAL CONTROL OF LEAF TRANSPIRATION,
W68-01109 02D

VASCULAR TISSUES
XEROPHYTIC STRUCTURES IN THE ROOTS OF DESERT SHRUBS,
W68-01170 02I

VEGETATION
OBSERVATIONS ONMICROCLIMATE AND VEGETATION INTERRELATIONSHIPS ON THE ACCRA PLAINS (GHANA),
W68-01077 02D

VEGETATION EFFECTS
PROTECTING OUR WATER RESOURCES,
W68-01345 03F

VEGETATION REGROWTH
SPECIES TRIALS IN THE SEMI-ARID SOUTHWEST OF NEW SOUTH WALES PART I--GRASSES AND LEGUMES,
W68-01074 03F

VELOCITY METERS
ULTRASONIC METHOD OF FLOW MEASUREMENT,
W68-01240 07B

VISCOUS FLOW
ON WAKES IN STRATIFIED FLUIDS,
W68-01040 08B

WASTE WATER TREATMENT
HOW TO OPERATE 'PACKAGE' WASTEWATER TREATMENT PLANTS,
W68-01020 05D

BALAS ALGORITHM FOR ZONED UNIFORM TREATMENT,
W68-01161 05D

A STUDY IN THE ECONOMICS OF WATER QUALITY MANAGEMENT,
W68-01165 05G

WASTE RECOVERY AND POLLUTION ABATEMENT,
W68-01322 05F

WATER ALLOCATION
TEMPORAL ALLOCATION OF GROUNDWATER,
W68-01060 06C

WATER ALLOCATION(POLICY)
LAND USE IMPLICATIONS OF SURFACE WATER ALLOCATION, CH 1 AND 2,
W68-01308 06D

LAND USE IMPLICATIONS OF SURFACE WATER ALLOCATION, CH 3 AND 4,
W68-01309 06D

WATER LAW AND DECISION-MAKING - A CRITIQUE,
W68-01400 06C

WATER CHEMISTRY
USE OF MERCUROUS CHLORIDE TO RECOVER TRACE AMOUNTS OF GOLD FROM WATERS,
W68-01124 02K

DISSOLVED-MINERAL INFLOW TO GREAT SALT LAKE AND CHEMICAL CHARACTERISTICS OF THE SALT LAKE - SUMMARY FOR WATER YEARS 1960, 1961, AND 1962,
W68-01249 02H

CHEMICAL GEOHYDROLOGY,
W68-01263 02K

WATER CIRCULATION
MANIPULATION OF RESERVOIR WATER FOR IMPROVED QUALITY AND FISH POPULATION RESPONSE.
W68-01143 05C

WATER CONSERVATION
WATER MUSHROOMING POPULATIONS,
W68-01344 06D

PROTECTING OUR WATER RESOURCES,
W68-01345 03F

WATER CONSUMPTION
WATER MUSHROOMING POPULATIONS,
W68-01344 06D

WATER COSTS
WATER COSTS.
W68-01183 06C

WATER DEMAND
THE IMPACT OF PRICE ON RESIDENTIAL WATER DEMAND AND ITS RELATION TO SYSTEM DESIGN AND PRICE STRUCTURE,
W68-01053 06D

ECONOMICS IN WATER RESEARCH,
W68-01115 06B

FUTURE WATER REQUIREMENTS.
W68-01184 06D

WATER DISTRIBUTION(APPLIED)
THE HIERARCHY OF WATER QUALITY,
W68-01257 03D

WATER DISTRICTS
STATE DISTRICT LAWS AS THEY AFFECT WATERSHED DEVELOPMENT,
W68-01326 04D

MODEL WATERSHED DISTRICT ACT,
W68-01327 04D

WATER HARVESTING
RAINFALL COLLECTION FOR DOMESTIC WATER SUPPLIES,
W68-01079 03F

WATER INJURY
DECISIONS RELATING TO DISTRIBUTION OF PUBLIC WATER SUPPLIES,
W68-01374 03D

WATER LAW
CLASSES OF WATER AND CHARACTER OF WATER RIGHTS AND USES - SECTION 51 WATER-LAW DOCTRINE,
W68-01290 06E

CLASSES OF WATER AND CHARACTER OF WATER RIGHTS AND USES - SECTION 52 THE PRINCIPAL CATEGORIES OF SURFACE AND GROUND WATERS,
W68-01291 06E

CLASSES OF WATER AND CHARACTER OF WATER RIGHTS AND USES - SECTION 53 NATURE OF PROPERTY RIGHTS IN WATER,
W68-01292 06E

TAX PROBLEMS RELATING TO WATER RIGHTS AND WATERWORKS - DIV C SPECIAL TAXES ON WATER AND ELECTRIC COMPANIES - DIV D FEDERAL INCOME TAX PROBLEMS RELATING TO WATER RIGHTS AND H2O WKS,
W68-01297 06E

POLICIES FOR WATER LAW PROPERTY RIGHTS, ECONOMIC FORCES, AND PUBLIC REGULATION,
W68-01312 06B

COMMON, PUBLIC, AND PRIVATE THINGS IN LOUISIANA CIVILIAN TRADITION AND MODERN PRACTICE (WATERBODIES),
W68-01340 06E

PRESENT WATER LAW AND PROGRAMS.

W68-01346 04A

LEGAL BASIS FOR WATER POLLUTION CONTROL,
W68-01352 06E

WATER USE LAW IN ACTION,
W68-01354 06E

REGULATION OF WATER USE IN LOCAL AREAS BY STATE OR LOCAL GOVERNMENTS AND DISTRICTS,
W68-01355 06E

EASTERN LAWS CONCERNING MINIMUM STREAM FLOWS AND IMPOUNDMENTS,
W68-01357 06E

WATER RIGHTS LAW IN KENTUCKY.
W68-01385 06E

WATER LEVEL FLUCTUATIONS
GROUND-WATER LEVELS IN NEW MEXICO, 1966,
W68-01266 04B

WATER LEVELS
WATER LEVEL PROBE,
W68-01021 07B

GROUNDWATER CONDITIONS IN THE WATERMAN WASH AREA, MARICOPA AND PINAL COUNTIES, ARIZONA,
W68-01028 04B

AVAILABILITY OF GROUND WATER IN THE OAKTON QUADRANGLE AND PART OF THE WOLF ISLAND QUADRANGLE IN JACKSON PURCHASE REGION, KENTUCKY,
W68-01117 04B

HYDROLOGICAL YEAR-BOOK OF ISRAEL 1965/66.
W68-01119 02A

AVAILABILITY OF GROUND WATER IN THE HICKMAN QUADRANGLE, KENTUCKY-MISSOURI-TENNESSEE,
W68-01122 03B

AVAILABILITY OF GROUND WATER IN PARTS OF THE CAIRO AND BARLOW QUADRANGLES IN THE JACKSON PURCHASE REGION, KENTUCKY,
W68-01134 04B

SUMMARY OF THE GEOLOGY AND GROUND-WATER RESOURCES OF PITT COUNTY, NORTH CAROLINA,
W68-01147 04B

GROUND-WATER LEVELS IN NEW MEXICO, 1966,
W68-01266 04B

WATER LOSS
THEORETICAL PREDICTION OF EVAPORATION LOSSES FROM GROUNDWATER,
W68-01172 02D

FLOW OF GROUNDWATER IN RELATIVELY THICK LEAKY AQUIFERS,
W68-01186 02F

WATER MANAGEMENT(ADMINISTRATIVE)
CHANGES IN RESOURCE MANAGEMENT,
W68-01363 06E

WATER MANAGEMENT(APPLIED)
WATER IN WEST PAKISTAN,
W68-01096 06E

THE OPTIMUM MANAGEMENT OF GROUND WATER RESOURCES,
W68-01156 04B

PLANNING FOR WATER RESOURCE DEVELOPMENT.
W68-01185 06B

INTEGRATING MANAGEMENT OF GROUND AND IMPORTED WATER IN LOS ANGELES COUNTY,
W68-01193 03D

WATER PIPES
PERFORMANCE OF DUCTILE-IRON PIPE IN SOILS,
W68-01194 08G

WATER POLICY
BALAS ALGORITHM FOR ZONED UNIFORM TREATMENT,
W68-01161 05D

WATER ECONOMICS RELATIONS TO LAW AND POLICY,
W68-01295 06E

POLICIES FOR WATER LAW PROPERTY RIGHTS, ECONOMIC FORCES, AND PUBLIC REGULATION,
W68-01312 06B

W68-01313 06B

QUESTIONS FOR DESIGNERS OF FUTURE WATER POLICY,
W68-01343 06B

WATER LAW AND POLICY IN THE SOUTHEAST.
W68-01348 06E

WATER POLLUTION
RECREATION BENEFITS FROM WATER POLLUTION CONTROL A FURTHER NOTE ON BENEFIT EVALUATION,
W68-01055 06B

WATER QUALITY DEGRADATION BY WOOD BARK POLLUTANTS,
W68-01269 05C

LIABILITY RESULTING FROM ARTIFICIAL BODIES OF WATER.
W68-01338 06E

DEVELOPMENT OF CENTRAL ADMINISTRATING CONTROL,
W68-01365 06E

WATER POLLUTION CONTROL IN THE GREAT LAKES REGION,
W68-01392 05G

WATER POLLUTION CONTROL
RECREATION BENEFITS FROM WATER POLLUTION CONTROL A FURTHER NOTE ON BENEFIT EVALUATION,
W68-01055 06B

USE OF SYSTEMS ANALYSIS IN ESTUARINE WATER POLLUTION CONTROL,
W68-01162 05G

REGULATORY ASPECTS OF FEDERAL POLLUTION CONTROL,
W68-01302 05G

WAR AGAINST WATER POLLUTION GETS MORE LIVELY.
W68-01304 05G

LEGAL BASIS FOR WATER POLLUTION CONTROL,
W68-01352 06E

WATER POLLUTION CONTROL IN NORTH CAROLINA,
W68-01353 06E

WATER PURITY A STUDY IN LEGAL CONTROL OF NATURAL RESOURCES,
W68-01360 05G

BASES OF RESOURCE REGULATION,
W68-01362 06E

CHANGES IN RESOURCE MANAGEMENT,
W68-01363 06E

OPERATION OF THE STATE CENTRAL ADMINISTRATIVE AGENCY,
W68-01366 06E

WATER POLLUTION CONTROL IN THE GREAT LAKES REGION,
W68-01392 05G

WATER PURIFICATION
CHANGES IN RESOURCE MANAGEMENT,
W68-01363 06E

WATER QUALITY
GROUND-WATER RESOURCES OF CHOWAN COUNTY, NORTH CAROLINA,
W68-01024 04B

GROUNDWATER CONDITIONS IN THE WATERMAN WASH AREA, MARICOPA AND PINAL COUNTIES, ARIZONA,
W68-01028 04B

AUTOMATED WATER QUALITY MONITORING,
W68-01049 05A

A STUDY IN THE ECONOMICS OF WATER QUALITY MANAGEMENT,
W68-01051 05G

QUALITY OF GROUNDWATER FOR IRRIGATION IN AHOR DEVELOPMENT BLOCK, JALORE DISTRICT, WESTERN RAJASTHAN,
W68-01091 03C

AVAILABILITY OF GROUND WATER IN THE OAKTON QUADRANGLE AND PART OF THE WOLF ISLAND QUADRANGLE IN JACKSON PURCHASE REGION, KENTUCKY,
W68-01117 04B

HYDROLOGICAL YEAR-BOOK OF ISRAEL 1965/66.
W68-01119 02A

AVAILABILITY OF GROUND WATER IN THE HICKMAN QUADRANGLE, KENTUCKY-MISSOURI-TENNESSEE,
W68-01122 03B

FLOW PATTERN AND RELATED CHEMICAL QUALITY OF GROUND WATER I THE '500-FOOT' SAND IN THE MEMPHIS AREA, TENNESSEE,
W68-01130 02F

AVAILABILITY OF GROUND WATER IN THE PARTS OF THE WICKLIFFE AND WICKLIFFE NW QUADRANGLES IN JACKSON PURCHASE REGION, KENTUCKY,
W68-01132 04B

AVAILABILITY OF GROUND WATER IN PARTS OF THE CAIRO AND BARLOW QUADRANGLES IN THE JACKSON PURCHASE REGION, KENTUCKY,
W68-01134 04B

MINERALS AND WATER, BUTLER COUNTY, ALABAMA.
W68-01137 03B

WATER RESOURCES OF THE SALISBURY AREA, MARYLAND,
W68-01141 03B

SUMMARY OF THE GEOLOGY AND GROUND-WATER RESOURCES OF PITT COUNTY, NORTH CAROLINA,
W68-01147 04B

GROUND-WATER RESOURCES OF WOOD COUNTY, TEXAS,
W68-01250 04B

HYDROLOGIC DATA 1966 VOLUME 3--CENTRAL COASTAL AREA, APPENDICES A-E.
W68-01259 02A

HYDROLOGIC DATA 1966 VOLUME V--SOUTHERN CALIFORNIA,

APPENDICES A-C.
W68-01260 02A

GEOLOGY AND GROUND WATER RESOURCES OF THE KALISPELL VALLEY, NORTHWESTERN MONTANA,
W68-01265 04B

GEOLOGY AND WATER RESOURCES OF THE HIBBING AREA, NORTHEASTERN MINNESOTA,
W68-01267 04B

CLASSES OF WATER AND CHARACTER OF WATER RIGHTS AND USES - SECTION 55 QUANTITY AND QUALITY OF SUPPLY,
W68-01294 06E

WATER QUALITY ACT
WATER QUALITY CONTROL ACT OF 1965.
W68-01359 05G

HEARINGS ON S4 BEFORE A SPECIAL SUBCOMMITTEE ON AIR AND WATER POLLUTION OF THE COMMITTEE ON PUBLIC WORKS, UNITED STATES SENATE.
W68-01370 05G

WATER QUALITY CONTROL
CLASSES OF WATER AND CHARACTER OF WATER RIGHTS AND USES - SECTION 55 QUANTITY AND QUALITY OF SUPPLY,
W68-01294 06E

HEARINGS ON S4 BEFORE A SPECIAL SUBCOMMITTEE ON AIR AND WATER POLLUTION OF THE COMMITTEE ON PUBLIC WORKS, UNITED STATES SENATE.
W68-01369 05G

WATER RATES
WATER COSTS.
W68-01183 06C

CAN WATER BE ALLOCATED BY COMPETITIVE PRICES,
W68-01383 06C

WATER REQUIREMENTS
INTERIM APPRAISAL OF OKLAHOMA BASINS PROJECT, OKLAHOMA WATER--THE KEY TO OKLAHOMA'S FUTURE.
W68-01131 06B

PRESENT USES AND WATER ECONOMY.
W68-01182 06B

FUTURE WATER REQUIREMENTS.
W68-01184 06D

WATER RESOURCES
WATER DATA FOR METROPOLITAN AREAS,
W68-01027 07A

MINERALS AND WATER, BUTLER COUNTY, ALABAMA.
W68-01137 03B

WATER RESOURCES OF THE SALISBURY AREA, MARYLAND,
W68-01141 03B

GEOLOGY AND GROUND-WATER RESOURCES OF THE LOWER BIGHORN VALLEY, MONTANA,
W68-01144 04B

A COMMENT ON OPTIMIZATION METHODS FOR BRANCHING MULTISTAGE WATER RESOURCE SYSTEMS,
W68-01158 06A

GEOLOGY AND GROUND WATER RESOURCES OF THE KALISPELL VALLEY, NORTHWESTERN MONTANA,
W68-01265 04B

GEOLOGY AND WATER RESOURCES OF THE HIBBING AREA, NORTHEASTERN MINNESOTA,
W68-01267 04B

PLAN AND SCOPE OF THE WORK (ON WATER AND WATER RIGHTS),
W68-01286 06E

BASES OF RESOURCE REGULATION,
W68-01362 06E

WATER RESOURCES DEVELOPMENT
WATER CONSERVATION BY RECLAMATION AND RECHARGE,
W68-01048 05D

WATER RESOURCE DEVELOPMENT IN CALIFORNIA,
W68-01058 06B

GROUND WATER IN ECONOMIC DEVELOPMENT,
W68-01090 03F

WATER IN WEST PAKISTAN,
W68-01096 06E

THE CURRENT FEDERAL PROGRAM FOR RIVER BASIN PLANNING AND THE NEED FOR ECONOMIC ANALYSIS,
W68-01113 06B

THE IMPORTANCE OF RESEARCH AND PLANNING IN WATER RESOURCE DEVELOPMENT,
W68-01114 06B

INTERIM APPRAISAL OF OKLAHOMA BASINS PROJECT, OKLAHOMA WATER--THE KEY TO OKLAHOMA'S FUTURE.
W68-01131 06B

POTENTIAL APPLICATIONS OF NUCLEAR EXPLOSIVES IN DEVELOPMENT AND MANAGEMENT OF WATER RESOURCES--PRELIMINARY CANVASS OF THE GROUND-WATER ENVIRONMENT,
W68-01142 08H

USE OF MODERN EQUIPMENT AND TECHNIQUES IN THE PLANNING AND DEVELOPMENT OF WATER RESOURCES,
W68-01160 06A

PLANNING FOR WATER RESOURCE DEVELOPMENT.
W68-01185 06B

PROGRESS REPORT ON WEST TEXAS AND EASTERN NEW MEXICO IMPORT PROJECT INVESTIGATION.
W68-01271 03F

SOME PHYSICAL, TECHNOLOGICAL, AND ECONOMIC CHARACTERISTICS OF WATER AND WATER RESOURCES SYSTEMS IMPLICATIONS FOR ADMINISTRATION,
W68-01341 06B

WATER SUPPLY ACT OF 1958.
W68-01342 06E

QUESTIONS FOR DESIGNERS OF FUTURE WATER POLICY,
W68-01343 06B

PRESENT WATER LAW AND PROGRAMS.
W68-01346 04A

PROGRESS REPORT.
W68-01367 03B

CAN WATER BE ALLOCATED BY COMPETITIVE PRICES,
W68-01383 06C

WATER RESOURCES PLANNING ACT
WATER RESOURCES PLANNING.
W68-01307 06B

WATER RESOURCES RESEARCH ACT
WATER RESOURCES RESEARCH PROGRAM.
W68-01306 06E

W68-01371 06D

WATER REUSE
WATER CONSERVATION BY RECLAMATION AND RECHARGE,
W68-01048 05D

WATER RIGHTS
THE EFFECTS OF VARYING LAND AND WATER USE ON STREAMFLOW REGIMEN,
W68-01261 04C

W68-01285 06E

TAX PROBLEMS RELATING TO WATER RIGHTS AND WATERWORKS - DIV A AND DIV B INTRODUCTION AND PROPERTY TAX,
W68-01296 06E

TAX PROBLEMS RELATING TO WATER RIGHTS AND WATERWORKS - DIV C SPECIAL TAXES ON WATER AND ELECTRIC COMPANIES - DIV D FEDERAL INCOME TAX PROBLEMS RELATING TO WATER RIGHTS AND H2O WKS,
W68-01297 06E

A FOUR STATE COMPARATIVE ANALYSIS OF PUBLIC RIGHTS IN WATER,
W68-01310 06B

POLICIES FOR WATER LAW PROPERTY RIGHTS, ECONOMIC FORCES, AND PUBLIC REGULATION,
W68-01313 06B

AGREEMENT IN RESPECT OF WATER RIGHTS IN STREAM AS CREATING A MERE PERSONAL OBLIGATION, COVENANT RUNNING WITH THE LAND, OR AN EASEMENT.
W68-01373 06E

WATER SHORTAGE
WATER BALANCE IN DESERT ARTHROPODS,
W68-01069 02I

WATER SOURCES
INTERIM APPRAISAL OF OKLAHOMA BASINS PROJECT, OKLAHOMA WATER--THE KEY TO OKLAHOMA'S FUTURE.
W68-01131 06B

WATER STORAGE
WATER SUPPLY ACT OF 1958.
W68-01342 06E

WATER SUPPLY
SUPPLY.
W68-01181 03B

PRESENT USES AND WATER ECONOMY.
W68-01182 06B

FUTURE WATER REQUIREMENTS.
W68-01184 06D

THE HIERARCHY OF WATER QUALITY,
W68-01257 03D

CLASSES OF WATER AND CHARACTER OF WATER RIGHTS AND USES - SECTION 55 QUANTITY AND QUALITY OF SUPPLY,
W68-01294 06E

AN ECONOMIC VIEW WATER PROBLEMS - NATIONAL AND REGIONAL,
W68-01318 06D

WATER RIGHTS LAW IN KENTUCKY.
W68-01385 06E

WATER RIGHTS LAW IN KENTUCKY - WATER SUPPLY OF KENTUCKY.
W68-01387 03B

WATER TABLE
REFRACTION DETERMINATION OF WATER TABLE DEPTH AND ALLUVIUM THICKNESS,
W68-01209 02F

WATER USERS
WATER USE LAW IN ACTION,
W68-01354 06E

WATER RIGHTS LAW IN KENTUCKY - WATER USE IN KENTUCKY.
W68-01388 03D

WATER UTILIZATION
THE DYNAMICS OF PUBLIC ROLES IN THE SELECTION OF REVENUE SOURCES IN LOCAL WATER ADMINISTRATION,
W68-01061 06C

WATER RESOURCES ALLOCATION, EXTRAMARKET VALUES, AND MARKET CRITERIA A SUGGESTED APPROACH,
W68-01111 06B

PRESENT USES AND WATER ECONOMY.
W68-01182 06B

W68-01285 06E

PUBLIC RIGHTS IN WATER USES AND PRIVATE RIGHTS IN LAND ADJACENT TO WATER - DIV A TRADITIONAL RIGHTS OF THE PUBLIC IN WATER USES,
W68-01288 06E

CLASSES OF WATER AND CHARACTER OF WATER RIGHTS AND USES - SECTION 54 BENEFICIAL AND REASONABLE USES OF WATER,
W68-01293 06E

AN ECONOMIC VIEW WATER PROBLEMS - NATIONAL AND REGIONAL,
W68-01318 06D

STATUTES FOR ADMINISTERING WATER USE IN THE SOUTHEAST,
W68-01350 06E

WATER USE LAW IN ACTION,
W68-01354 06E

WATER RIGHTS LAW IN KENTUCKY - WATER USE IN KENTUCKY.
W68-01388 03D

COMMONALITY, THE PRICE SYSTEM, AND USE OF WATER SUPPLIES,
W68-01399 06C

WATER LAW AND DECISION-MAKING A CRITIQUE,
W68-01400 06C

WATER UTILIZATION EFFICIENCY
WATER MUSHROOMING POPULATIONS,
W68-01344 06D

WATER WELLS
GROUND-WATER RESOURCES OF CHOWAN COUNTY, NORTH CAROLINA,
W68-01024 04B

GROUND-WATER RESOURCES OF THE APPALACHIAN REGION,
W68-01140 03B

GROUND-WATER RESOURCES OF WOOD COUNTY, TEXAS,
W68-01250 04B

WATER YIELD
FLOW PATTERN AND RELATED CHEMICAL QUALITY OF GROUND WATER IN THE '500-FOOT' SAND IN THE MEMPHIS AREA, TENNESSEE,
W68-01130 02F

GROUND-WATER RESOURCES OF THE APPALACHIAN REGION,
W68-01140 03B

WATER RESOURCES OF THE SALISBURY AREA, MARYLAND,
W68-01141 03B

GEOLOGY AND GROUND WATER RESOURCES OF THE KALISPELL VALLEY, NORTHWESTERN MONTANA,
W68-01265 04B

WATERCOURSES(LEGAL)
COMMON, PUBLIC, AND PRIVATE THINGS IN LOUISIANA CIVILIAN TRADITION AND MODERN PRACTICE (WATERBODIES),
W68-01340 06E

A SHORT COURSE ON WATER LAW FOR THE EASTERN UNITED STATES,
W68-01368 06E

WATERSHED MANAGEMENT
MULTIPLE LAND USE MANAGEMENT,
W68-01319 06B

RELATIONSHIPS BETWEEN WATER AND OTHER PROPERTY RIGHTS AND SMALL WATERSHED DEVELOPMENT IN THE EASTERN STATES,
W68-01325 04D

STATE DISTRICT LAWS AS THEY AFFECT WATERSHED DEVELOPMENT,
W68-01326 04D

MODEL WATERSHED DISTRICT ACT,
W68-01327 04D

WATERSHED PROTECT
ECONOMIC EVALUATION OF THE SMALL WATERSHED PROGRAM,
W68-01378 04D

WATERSHEDS
HYDROLOGY OF THE LEWIS GLACIER, NORTH-CENTRAL BAFFIN ISLAND, N W T, AND DISCUSSION OF RELIABILITY OF THE MEASUREMENTS.
W68-01041 02C

INTEGRATING FARM AND WATERSHED PLANNING IN SOIL AND WATER RESOURCE MANAGEMENT,
W68-01234 03F

WATERSHEDS(BASINS)
HYDROLOGIC DATA FOR EXPERIMENTAL AGRICULTURAL WATERSHEDS IN THE UNITED STATES, 1962,
W68-01121 04D

WATER RIGHTS LAW IN KENTUCKY - WATER SUPPLY OF KENTUCKY.
W68-01387 03B

WATERSHEDS(DIVIDES)
REAL PROPERTY - RIPARIAN RIGHTS,
W68-01381 06E

WATER-LEVEL FLUCTUATIONS
ELECTRICAL-ANALOG ANALYSIS OF GROUND-WATER DEPLETION IN CENTRAL ARIZONA,
W68-01034 04B

WAVES
WAVE PROPAGATION AND BOUNDARY INSTABILITY IN ERODIBLE-BED CHANNELS,
W68-01236 08B

WAVES(WATER)
GROWTH OF SPECTRAL COMPONENTS IN A WIND-GENERATED WAVE TRAIN,
W68-01030 08B

WEATHER PATTERNS
PRECIPITATION CLIMATOLOGY OF LAKE MICHIGAN BASIN,
W68-01254 02B

WEED CONTROL
THE CONTROL OF WATER WEEDS,
W68-01235 04A

WELFARE
A SOCIALLY OPTIMUM PRICING POLICY FOR A PUBLIC WATER AGENCY,
W68-01057 06C

WELFARE(ECONOMICS)
POLICIES FOR WATER LAW PROPERTY RIGHTS, ECONOMIC FORCES, AND PUBLIC REGULATION,
W68-01312 06B

WIND EROSION
A MONTHLY CLIMATIC FACTOR FOR THE WIND EROSION EQUATION,
W68-01086 02G

WIND SPEED
NEW DISTRIBUTIONS OF EXTREME WINDS IN THE UNITED STATES,
W68-01200 07A

WIND TIDES
GROWTH OF SPECTRAL COMPONENTS IN A WIND-GENERATED WAVE TRAIN,
W68-01030 08B

WIND(METEOROLOGY)
NEW DISTRIBUTIONS OF EXTREME WINDS IN THE UNITED STATES,
W68-01200 07A

WISCONSIN
A FOUR STATE COMPARATIVE ANALYSIS OF PUBLIC RIGHTS IN WATER,
W68-01310 06B

WATER PURITY A STUDY IN LEGAL CONTROL OF NATURAL RESOURCES,
W68-01360 05G

W68-01361 06E

BASES OF RESOURCE REGULATION,
W68-01362 06E

CHANGES IN RESOURCE MANAGEMENT,
W68-01363 06E

TRANSITION TO CENTRAL ADMINISTRATIVE CONTROL,
W68-01364 06E

DEVELOPMENT OF CENTRAL ADMINISTRATING CONTROL,
W68-01365 06E

OPERATION OF THE STATE CENTRAL ADMINISTRATIVE AGENCY,
W68-01366 06E

WITHDRAWAL
ELECTRICAL-ANALOG ANALYSIS OF GROUND-WATER DEPLETION IN CENTRAL ARIZONA,
W68-01034 04B

WOOD WASTES
WATER QUALITY DEGRADATION BY WOOD BARK POLLUTANTS,
W68-01269 05C

YEASTS
INTERACTION OF DIPYRIDYLIUM HERBICIDES AND SOIL MICROORGANISMS,

W68-01282 05B

ZONING
SALAS ALGORITHM FOR ZONED UNIFORM TREATMENT,
W68-01161 05D

2-4 D
PERSISTENCE OF DIQUAT, PARAQUAT, AND 2,4-DBEE WHEN USED FOR EURASIAN WATERMILFOIL CONTROL,
W68-01279 04A

AUTHOR INDEX

ACKERMAN, EDWARD A.
QUESTIONS FOR DESIGNERS OF FUTURE WATER POLICY,
W68-01343 06B

ADAMS, MILTON P.
WATER POLLUTION CONTROL IN THE GREAT LAKES REGION,
W68-01392 05G

ADAMS, PAUL L.
DIVERSION OF LAKE MICHIGAN WATERS,
W68-01380 05E

ALGER, GEORGE
CHARACTERISTICS OF INTERFACE FLOW IN SUBSURFACE DISPOSAL SYSTEMS,
W68-01245 05G

ALJIBURY, F. K.
EFFECTS OF SURFACE SEDIMENTS ON GROUNDWATER RECHARGE,
W68-01085 04B

ALLEN, R. R.
LANDFORMING FOR LEACHING OF SALINE SOILS IN A NONIRRIGATED AREA,
W68-01087 03F

ALLISON, STEPHEN V.
USE OF MODERN EQUIPMENT AND TECHNIQUES IN THE PLANNING AND DEVELOPMENT OF WATER RESOURCES,
W68-01160 06A

ALSPAUGH, JAMES A.
REAL PROPERTY - RIPARIAN RIGHTS,
W68-01381 06E

ANDERSON, D. M.
EFFECTS OF TEMPERATURE AND PRESSURE ON UNFROZEN SOIL WATER,
W68-01264 02C

ANDERSON, D. V.
OPTIMAL GROUND-WATER MINING,
W68-01110 06A

ANDERSON, T. W.
ELECTRICAL-ANALOG ANALYSIS OF GROUND-WATER DEPLETION IN CENTRAL ARIZONA,
W68-01034 04B

ANDREW, W. D.
MOISTURE AND TEMPERATURE REQUIREMENTS FOR GERMINATION OF THREE ANNUAL SPECIES OF MEDICAGO,
W68-01107 02I

APOLINSKY, HAROLD I.
THE DEVELOPMENT OF RIPARIAN LAW IN ALABAMA,
W68-01401 06E

ARMBRUST, DEAN V.
A MONTHLY CLIMATIC FACTOR FOR THE WIND EROSION EQUATION,
W68-01086 02G

ARMSTRONG, DAVID E.
ADSORPTION CATALYZED CHEMICAL HYDROLYSIS OF ATRAZINE,
W68-01246 03F

ATKINSON, A. W., JR.
EFFECT OF MORPHACTINS ON BEAN AND ALLIGATORWEED,
W68-01284 04A

AVICHAI, Y.
A STATISTICAL INVESTIGATION OF PERSISTENCE IN THE ISRAELI ARTIFICIAL RAINFALL STIMULATION EXPERIMENT,
W68-01094 03B

AVI-ITZHAK, B.
A PROBLEM OF OPTIMIZING A COLLECTING RESERVOIR SYSTEM,
W68-01151 08A

AYER, G. R.
STREAMS IN DUTCHESS COUNTY, NEW YORK--THEIR FLOW CHARACTERISTICS AND WATER QUALITY IN RELATION TO WATER PROBLEMS,
W68-01042 04A

BABCOCK, RUSSELL H.
SELECTIVE ION ELECTRODE SYSTEM FOR FLUORIDE ANALYSIS,
W68-01116 07B

BABE, BILLY
TIME OF FERTILIZER APPLICATION ON DESERT GRASSLANDS,
W68-01068 03F

BAIER, D. D.
EFFECTS OF SURFACE SEDIMENTS ON GROUNDWATER RECHARGE,
W68-01085 04B

BAIN, JOSEPH S.
WATER RESOURCE DEVELOPMENT IN CALIFORNIA,
W68-01058 06B

BAIRD, RALPH W.
FIELD AND LABORATORY EXPERIMENTAL APPROACHES,
W68-01233 02E

BALLINGER, DWIGHT G.
AUTOMATED WATER QUALITY MONITORING,
W68-01049 05A

BARDIN, R.
OVERHEAD IRRIGATION ENCOURAGES WET-WEATHER PLANT DISEASES,
W68-01192 03F

BARNETT, D. M.
DEVELOPMENT, LANDFORMS AND CHRONOLOGY OF GENERATOR LAKE, BAFFIN ISLAND, N W T,
W68-01035 02C

BARRAUD, Y.
THE USE OF SOIL MECHANICS METHODS FOR ADAPTING TOWER FOUNDATIONS TO SOIL CONDITIONS,
W68-01212 08D

BARTELS, L. F.
A COMPARISON OF GYPSUM BLOCKS AND EVAPORIMETERS FOR IRRIGATION CONTROL,
W68-01104 03F

BARTSCH, A. F.
EUTROPHICATION IS BEGINNING IN LAKE MICHIGAN,
W68-01244 05C

BAYLY, I. A. E.
CHEMICAL AND BIOLOGICAL STUDIES ON SOME SALINE LAKES OF SOUTH-EAST AUSTRALIA,
W68-01082 02H

BAYUSHEVA, M. I.
SPRING SLOPE RUNOFF FROM THE PRINCIPAL AGRICULTURAL LANDS OF THE KULUNDA STEPPE,
W68-01174 02C

BELL, EDWIN A.
FLOW PATTERN AND RELATED CHEMICAL QUALITY OF GROUND WATER IN THE '500-FOOT' SAND IN THE MEMPHIS AREA, TENNESSEE,
W68-01130 02F

BENETT, EDWARD J.
COLBERG, INC V STATE RIPARIAN LANDOWNER'S RIGHT TO EMINENT DOMAIN RELIEF FOR STATE IMPAIRMENT OF ACCESS TO A NAVIGABLE WATERWAY,
W68-01314 06E

BENNETT, JOHN H.
GEODIMETER FAULT MOVEMENT INVESTIGATIONS IN CALIFORNIA,
W68-01224 08E

BENSON, MANUEL A.
AVERAGE PROBABILITY OF EXTREME EVENTS,
W68-01059 06F

BEN-TUVIA, S.
A PROBLEM OF OPTIMIZING A COLLECTING RESERVOIR SYSTEM,
W68-01151 08A

BEUCHERT, EDWARD
ZONING ON THE FLOOD PLAIN,
W68-01316 06F

BHAN, SURAJ
RECLAMATION OF THE RAJPUTANA DESERT,
W68-01242 04A

BIAREZ, J.
THE USE OF SOIL MECHANICS METHODS FOR ADAPTING TOWER FOUNDATIONS TO SOIL CONDITIONS,
W68-01212 08D

BIBANOV, V. I.
APPLICATION OF SEISMIC EXPLORATION METHODS IN ENGINEERING-GEOLOGICAL INVESTIGATIONS,
W68-01223 08E

BIRCH, F. H.
EXPERIENCE WITH TRANSISTORISED PROTECTION IN BRITAIN,
W68-01215 08C

BIRKHEAD, GUTHRIE S.
WATER IN WEST PAKISTAN,
W68-01054 06B

W68-01096 06E

BOGGESS, DURWARD H.
WATER RESOURCES OF THE SALISBURY AREA, MARYLAND,
W68-01141 03B

BOREN, P.
WATER LEVEL PROBE,
W68-01021 07B

BOSCH, H.
RESULTS IN HVDC CONVERTOR TESTING AND UTILIZATION OF THE RHEINAU RESEARCH LABORATORY FACILITIES,
W68-01219 08C

BOUTWELL, GORDON P., JR.
THEORETICAL STUDIES OF CRATERING MECHANISMS AFFECTING THE STABILITY OF CRATERED SLOPES,
W68-01195 08D

BOWER, BLAIR T.
SOME PHYSICAL, TECHNOLOGICAL, AND ECONOMIC CHARACTERISTICS OF WATER AND WATER RESOURCES SYSTEMS IMPLICATIONS FOR ADMINISTRATION,

W68-01341 06B

BOZARTH, G. A.
REVIEW OF THE METABOLISM AND DECOMPOSITION OF DIQUAT AND PARAQUAT,
W68-01275 05A

BRANSON, F. A.
GEOGRAPHIC DISTRIBUTION AND FACTORS AFFECTING THE DISTRIBUTION OF SALT DESERT SHRUBS IN THE UNITED STATES,
W68-01176 02I

BRICE, J. C.
SCOUR AND FILL IN ALLUVIAL CHANNELS WITH PARTICULAR REFERENCE TO BRIDGE SITES,
W68-01139 08A

BRIETKRIETZ, ALEX
GEOLOGY AND GROUND WATER RESOURCES OF THE KALISPELL VALLEY, NORTHWESTERN MONTANA,
W68-01265 04B

BROOM, H. E.
GROUND-WATER RESOURCES OF WOOD COUNTY, TEXAS,
W68-01250 04B

BROWN, GARDNER, JR.
A SOCIALLY OPTIMUM PRICING POLICY FOR A PUBLIC WATER AGENCY,
W68-01057 06C

BROWN, ROBERT J.
UNUSUAL MONOMIXIS IN TWO SALINE ARIZONA PONDS,
W68-01095 03C

BUCKNER, W.
STRESSES IN TRANSMISSION LINE CONDUCTORS NEAR THE SUSPENSION CLAMP,
W68-01213 08C

BUOL, S. W.
MICROMORPHOLOGICAL STUDY OF SOIL CRUSTS,
W68-01097 03F

BURCAR, PATRICIA J.
PHYSICAL-CHEMICAL PROPERTIES OF NATURALLY OCCURRING POLYELECTROLYTES--(PART) 1, SODIUM HUMATE,
W68-01253 02K

BURRELL, DONALD
THE RIGHTS OF A RIPARIAN LANDOWNER IN MISSOURI,
W68-01390 06E

BURT, OSCAR R.
TEMPORAL ALLOCATION OF GROUNDWATER,
W68-01060 06C

BURYKIN, A. M.
RATES OF EROSION AND SOIL FORMATION (IN THE HUMID AND ARID SUBTROPICS OF THE USSR),
W68-01169 02J

BUSBY, C. E.
AMERICAN WATER RIGHTS LAW,
W68-01398 06E

BUSCH, F. E.
GROUND-WATER LEVELS IN NEW MEXICO, 1966,
W68-01266 04B

BYBORDI, M.
EFFECT OF SOIL MOISTURE DEPLETION ON CROP YIELD AND STOMATAL INFILTRATION,
W68-01189 03F

CALDWELL, LYNTON K.
AN ECOSYSTEMS APPROACH TO PUBLIC LAND POLICY,
W68-01206 06G

CALECA, V.
STUDIES ON THE INTEGRATION OF A D-C TRANSMISSION LINE INTO AN A-C NETWORK,
W68-01218 08C

CARTER, R. W.
GENERAL PROCEDURE FOR GAGING STREAMS,
W68-01138 07A

CASE, C. M.
OPTIMAL GROUND-WATER MINING,
W68-01110 06A

CASSON, W.
A TECHNICAL AND ECONOMIC COMPARISON BETWEEN AC AND DC TRANSMISSION,
W68-01217 08C

CASTLE, EMERY N.
WATER RESOURCES ALLOCATION, EXTRAMARKET VALUES, AND MARKET CRITERIA A SUGGESTED APPROACH,
W68-01111 06B

CHAMPION, HOBERT R.
SUGAR CANE IRRIGATION A CASE STUDY IN CAPITAL BUDGETING,
W68-01164 03F

CHANGNON, STANLEY A., JR.
PRECIPITATION CLIMATOLOGY OF LAKE MICHIGAN BASIN,
W68-01254 02B

CHAO, T. T.
USE OF MERCUROUS CHLORIDE TO RECOVER TRACE AMOUNTS OF GOLD FROM WATERS,
W68-01124 02K

CHESTERS, GORDON
ADSORPTION CATALYZED CHEMICAL HYDROLYSIS OF ATRAZINE,
W68-01246 03F

CHRISTENSEN, N. H.
RIGID PIPES IN SYMMETRICAL AND UNSYMMETRICAL TRENCHES,
W68-01207 08D

CIRIACY-WANTRUP, S. V.
WATER ECONOMICS RELATIONS TO LAW AND POLICY,
W68-01295 06E

SOME ECONOMIC ISSUES IN WATER RIGHTS,
W68-01382 06D

CLARK, M.
EFFECT OF SOIL SALINITY ON WATER POTENTIALS AND TRANSPIRATION IN PEPPER (CAPSICUM FRUTESCENS),
W68-01072 03F

CLARK, ROBERT EMMET

W68-01285 06E

PLAN AND SCOPE OF THE WORK (ON WATER AND WATER RIGHTS),
W68-01286 06E

CLARK, ROBERT E.
(THE COMMERCE CLAUSE AND THE NAVIGATION POWER),
W68-01298 06E

(THE NEED FOR RECONSIDERATION OF THE NAVIGATION SERVITUDE),
W68-01299 06E

(THE FEDERAL PROPRIETARY POWER IN WATER RIGHTS).
W68-01300 06E

(THE NEED FOR A NATIONAL WATER POLICY),
W68-01301 06E

CLARK, R.
CLASSES OF WATER AND CHARACTER OF WATER RIGHTS AND USES - SECTION 51 WATER-LAW DOCTRINE,
W68-01290 06E

CLASSES OF WATER AND CHARACTER OF WATER RIGHTS AND USES - SECTION 52 THE PRINCIPAL CATEGORIES OF SURFACE AND GROUND WATERS,
W68-01291 06E

CLASSES OF WATER AND CHARACTER OF WATER RIGHTS AND USES - SECTION 53 NATURE OF PROPERTY RIGHTS IN WATER,
W68-01292 06E

CLASSES OF WATER AND CHARACTER OF WATER RIGHTS AND USES - SECTION 54 BENEFICIAL AND REASONABLE USES OF WATER,
W68-01293 06E

CLASSES OF WATER AND CHARACTER OF WATER RIGHTS AND USES - SECTION 55 QUANTITY AND QUALITY OF SUPPLY,
W68-01294 06E

CLEARY, WILLIAM J.
SEDIMENTATION IN ONSLOW BAY (IN GUIDEBOOK FOR FIELD EXCURSIONS, GEOLOGICAL SOCIETY OF AMERICA, SOUTHEASTERN SECTION),
W68-01262 02L

CLUFF, C. BRENT
RAFTS NEW WAY TO CONTROL EVAPORATION,
W68-01067 03F

CLYDE, CALVIN G.
OPTIMIZING CONJUNCTIVE USE OF SURFACE WATER AND GROUNDWATER,
W68-01155 02A

CLYDE, EDWARD W.
(THE COMMERCE CLAUSE AND THE NAVIGATION POWER),
W68-01298 06E

(THE NEED FOR RECONSIDERATION OF THE NAVIGATION SERVITUDE),
W68-01299 06E

(THE FEDERAL PROPRIETARY POWER IN WATER RIGHTS).
W68-01300 06E

(THE NEED FOR A NATIONAL WATER POLICY),
W68-01301 06E

CLYMA, WAYNE
NATURAL RECHARGE IN TUCSON BASIN,
W68-01080 04B

COATS, G. E.
FACTORS AFFECTING PERSISTENCE AND INACTIVATION OF DIQUAT AND PARAQUAT,
W68-01274 05B

COLE, GERALD A.
UNUSUAL MONOMIXIS IN TWO SALINE ARIZONA PONDS,
W68-01095 03C

CONSTANTIN, G. K.
BULK VOLUME AND HYDRAULIC CONDUCTIVITY CHANGES DURING SODIUM SATURATION TESTS,
W68-01070 02G

COOK, FRANK A.

FLUVIAL PROCESSES IN THE HIGH ARCTIC,
W68-01029 02C

CORKER, CHARLES E.
(THE COMMERCE CLAUSE AND THE NAVIGATION POWER),
W68-01298 06E

(THE NEED FOR RECONSIDERATION OF THE NAVIGATION SERVITUDE),
W68-01299 06E

(THE FEDERAL PROPRIETARY POWER IN WATER RIGHTS).
W68-01300 06E

(THE NEED FOR A NATIONAL WATER POLICY),
W68-01301 06E

CORNACK, MURRAY
INTEGRATING FARM AND WATERSHED PLANNING IN SOIL AND WATER RESOURCE MANAGEMENT,
W68-01234 03F

COVEY, WINTON GUY, JR.
STUDIES OF THE DRYING OF BARE GROUND,
W68-01076 02D

CRAIG, R. KENNETH
INSECTICIDES IN TILE DRAINAGE EFFLUENT,
W68-01191 05G

CRICE, DOUGLAS B.
GEODIMETER FAULT MOVEMENT INVESTIGATIONS IN CALIFORNIA,
W68-01224 08E

CULBERTSON, D. M.
SCOUR AND FILL IN ALLUVIAL CHANNELS WITH PARTICULAR REFERENCE TO BRIDGE SITES,
W68-01139 08A

CURL, E. A.
INTERACTION OF DIPYRIDYLIUM HERBICIDES AND SOIL MICROORGANISMS,
W68-01282 05B

DALY, R. W.
PERSISTENCE OF DIQUAT, PARAQUAT, AND 2,4-DBEE WHEN USED FOR EURASIAN WATERMILFOIL CONTROL,
W68-01279 04A

DANDERS, M.
RESULTS IN HVDC CONVERTOR TESTING AND UTILIZATION OF THE RHEINAU RESEARCH LABORATORY FACILITIES,
W68-01219 08C

DAVIDIAN, JACOB
GENERAL PROCEDURE FOR GAGING STREAMS,
W68-01138 07A

DAVIS, CHARLES RAY
IMPLIED COVENANT TO PROTECT LEASED PREMISES FROM DRAINAGE WHERE LESSEE IS RESPONSIBLE FOR DRAINAGE,
W68-01336 04C

DAVIS, EUGENE
WATER RIGHTS IN IOWA,
W68-01384 06E

DAVIS, ROBERT K.
COMPARISONS OF METHODS FOR RECREATION EVALUATION,
W68-01063 06B

DEACON, JAMES E.
SOUTHWESTERN FISHES AND THE ENIGMA OF 'ENDANGERED SPECIES',
W68-01102 06G

DENIS, E. E.
GROUNDWATER CONDITIONS IN THE WATERMAN WASH AREA, MARICOPA AND PINAL COUNTIES, ARIZONA,
W68-01028 04B

DENNY, KLEBER J.
GRAIN SIZE DISTRIBUTION AND ITS EFFECT ON THE PERMEABILITY OF UNCONSOLIDATED SANDS,
W68-01175 02G

DIAZ, JAMIE E.
OWNERSHIP OF BEDS OF NAVIGABLE WATERS,
W68-01393 06E

DILLARD, J. K.
1100-KV STATION AND LINE INSULATION DESIGN,
W68-01214 08C

DOMENICO, P. A.
OPTIMAL GROUND-WATER MINING,
W68-01110 06A

DONDERO, NORMAN C.
ADAPTATION BY MICROBIAL POPULATIONS,
W68-01168 05D

DORFMAN, ROBERT
MATHEMATICAL MODELS THE MULTISTRUCTURE APPROACH TWO SEASONS, PREDICTABLE HYDROLOGY,
W68-01153 06A

MATHEMATICAL MODELS THE MULTISTRUCTURE APPROACH MORE PERIODS, PREDICTABLE HYDROLOGY,
W68-01163 06A

MATHEMATICAL MODELS THE MULTISTRUCTURE APPROACH ALLOWANCE FOR UNCERTAINTY,
W68-01166 06A

DOUGHERTY, J. J.
STUDIES ON THE INTEGRATION OF A D-C TRANSMISSION LINE INTO AN A-C NETWORK,
W68-01218 08C

DRACUP, JOHN A.
THE OPTIMUM MANAGEMENT OF GROUND WATER RESOURCES,
W68-01156 04B

DUGUID, JAMES OTTO
REFRACTION DETERMINATION OF WATER TABLE DEPTH AND ALLUVIUM THICKNESS,
W68-01209 02F

DUNN, JAMES E.
RESISTANCE OF TEXAS SALT - AND FRESHWATER - MARSH FISHES TO HEAT DEATH AT VARIOUS SALINITIES,
W68-01073 05C

DUPREY, J. N.
AN ECONOMIC VIEW WATER PROBLEMS - NATIONAL AND REGIONAL,
W68-01318 06D

EDINGER, JOHN ERIC
ANALYZING STEAM ELECTRIC POWER PLANT DISCHARGES,
W68-01026 05B

EDNEY, E. B.
WATER BALANCE IN DESERT ARTHROPODS,
W68-01069 02I

EHLIG, C. F.
EFFECT OF SOIL SALINITY ON WATER POTENTIALS AND TRANSPIRATION IN PEPPER (CAPSICUM FRUTESCENS),
W68-01072 03F

EIDINGER, A.
TRANSIENT RECOVERY VOLTAGE CAUSED BY DIFFERENT SWITCHING OPERATIONS IN HV NETWORKS CONTAINING UNDERGROUND CABLES,
W68-01211 08C

EISENHART, CHURCHILL
EXPRESSION OF THE UNCERTAINTIES OF FINAL RESULTS,
W68-01204 07C

EL ABEDEINE, ABDALLA Z.
A PRELIMINARY STUDY ON THE EFFECT OF ARTIFICIALLY CREATED LAYERS IN SANDY SOILS ON YIELD OF ALFALFA,
W68-01099 03F

ELLIS, HAROLD H.
RELATIONSHIPS BETWEEN WATER AND OTHER PROPERTY RIGHTS AND SMALL WATERSHED DEVELOPMENT IN THE EASTERN STATES,
W68-01325 04D

SOME CURRENT AND PROPOSED WATER-RIGHTS LEGISLATION IN THE EASTERN STATES,
W68-01347 06E

REGULATION OF WATER USE IN LOCAL AREAS BY STATE OR LOCAL GOVERNMENTS AND DISTRICTS,
W68-01355 06E

ETTER, P.
RESULTS IN HVDC CONVERTOR TESTING AND UTILIZATION OF THE RHEINAU RESEARCH LABORATORY FACILITIES,
W68-01219 08C

EVANS, D. D.
MICROMORPHOLOGICAL STUDY OF SOIL CRUSTS,
W68-01097 03F

FANELLI, MICHELE
MEASURING INTERNAL TEMPERATURES IN MASS CONCRETE,
W68-01203 08G

FARR, S. S. T.
NONSTEADY COMPRESSIBLE FLOW THROUGH ANISOTROPIC POROUS MEDIUMS WITH PARTICULAR REFERENCE TO SNOW,
W68-01128 02C

FEDOROVICH, D. I.
GROUNDWATER SEEPAGE RATES,
W68-01237 02F

FERRY, G. V.
PREHARVEST WATER STRESS FOR VALLEY SUGAR BEETS,
W68-01101 03F

FIERING, MYRON B.
SIMULATION OF A NATIONAL FLOOD INSURANCE FUND,
W68-01062 06F

FISCHER, HUGO B.
METHODS FOR PREDICTING DISPERSION COEFFICIENTS IN NATURAL STREAMS, WITH APPLICATIONS TO LOWER REACHES OF THE GREEN AND DUWAMISH RIVERS, WASH.,
W68-01145 02E

FISHMAN, MARVIN J.
DETERMINATION OF MOLYBDENUM IN FRESH WATERS - A COMPARISON OF METHODS,
W68-01046 02K

FORER, LOIS G.
WATER SUPPLY SUGGESTED FEDERAL REGULATION,
W68-01317 03B

FREEMAN, A MYRICK, III.

SIX FEDERAL RECLAMATION PROJECTS AND THE DISTRIBUTION OF INCOME,
W68-01056 06B

FRITSCHEN, LEO J.
EVAPOTRANSPIRATION RATES OF FIELD CROPS DETERMINED BY THE BOWEN RATIO METHOD,
W68-01106 03F

FRITTS, HAROLD C.
CONDITIONAL PROBABILITY OF OCCURRENCE FOR VARIATIONS IN CLIMATE BASED ON WIDTHS OF ANNUAL TREE RINGS IN ARIZONA,
W68-01251 02B

FUEHRING, H. D.
EFFECT OF SOIL MOISTURE DEPLETION ON CROP YIELD AND STOMATAL INFILTRATION,
W68-01189 03F

FUNDERBURK, H. H., JR.
FACTORS AFFECTING PERSISTENCE AND INACTIVATION OF DIQUAT AND PARAQUAT,
W68-01274 05B

REVIEW OF THE METABOLISM AND DECOMPOSITION OF DIQUAT AND PARAQUAT,
W68-01275 05A

PHOTOCHEMICAL DECOMPOSITION OF DIQUAT AND PARAQUAT,
W68-01276 05A

CHEMICALS MAY CONTROL STUBBORN ALLIGATORWEED,
W68-01277 04A

THE EFFECT OF DICHLOBENIL AND DICAMBA ON NODAL TISSUES OF ALLIGATORWEED,
W68-01278 04A

PERSISTENCE OF DIQUAT, PARAQUAT, AND 2,4-DBEE WHEN USED FOR EURASIAN WATERMILFOIL CONTROL,
W68-01279 04A

EFFECTIVENESS OF HERBICIDAL COMBINATIONS ON ALLIGATORWEED GROWING IN FLOWING WATER,
W68-01280 04A

METABOLISM OF FLUOMETURON BY SEVERAL BIOLOGICAL SYSTEMS,
W68-01281 05A

INTERACTION OF DIPYRIDYLIUM HERBICIDES AND SOIL MICROORGANISMS,
W68-01282 05B

ABSORPTION, TRANSLOCATION, AND METABOLISM OF C-14-LABELED DICHLOBENIL,
W68-01283 04A

EFFECT OF MORPHACTINS ON BEAN AND ALLIGATORWEED,
W68-01284 04A

GABRIEL, K. R.
A STATISTICAL INVESTIGATION OF PERSISTENCE IN THE ISRAELI ARTIFICIAL RAINFALL STIMULATION EXPERIMENT,
W68-01094 03B

GAMBEL, CHARLES R.
MAGNITUDE AND FREQUENCY OF FLOODS IN THE UNITED STATES PART 5. HUDSON BAY AND UPPER MISSISSIPPI RIVER BASIN,
W68-01023 02E

GARDNER, W. R.
EFFECT OF SOIL SALINITY ON WATER POTENTIALS AND TRANSPIRATION IN PEPPER (CAPSICUM FRUTESCENS),
W68-01072 03F

GARRISON, CHARLES L.
THE DYNAMICS OF PUBLIC ROLES IN THE SELECTION OF REVENUE SOURCES IN LOCAL WATER ADMINISTRATION,
W68-01061 06C

GATES, WILLIAM E.
PILOT PLANT STUDIES ON THE ANAEROBIC TREATMENT OF TANNERY EFFLUENTS,
W68-01125 05D

GEORGE, VERNON EDWARD
LAND USE IMPLICATIONS OF SURFACE WATER ALLOCATION, CH 1 AND 2,
W68-01308 06D

LAND USE IMPLICATIONS OF SURFACE WATER ALLOCATION, CH 3 AND 4,
W68-01309 06D

GESSFORD, JOHN
OPTIMAL POLICY FOR HYDROELECTRIC OPERATIONS,
W68-01150 08C

GEYER, JOHN C.
ANALYZING STEAM ELECTRIC POWER PLANT DISCHARGES,
W68-01026 05B

GIBBS, HAROLD J.
RESEARCH ON ELECTRORECLAMATION OF SALINE-ALKALI SOILS,
W68-01108 02K

GILLESPIE, GLENN A.
WATER-ORIENTED OUTDOOR RECREATION,
W68-01112 06D

GINZBURG, CHEN

XEROPHYTIC STRUCTURES IN THE ROOTS OF DESERT SHRUBS,
W68-01170 02I

GLASER, R. GEORGE
SUGAR CANE IRRIGATION A CASE STUDY IN CAPITAL BUDGETING,
W68-01164 03F

GRABEK, V. B.
APPLICATION OF SEISMIC EXPLORATION METHODS IN ENGINEERING-GEOLOGICAL INVESTIGATIONS,
W68-01223 08E

GRADOWCZYK, MARIO H.
WAVE PROPAGATION AND BOUNDARY INSTABILITY IN ERODIBLE-BED CHANNELS,
W68-01236 08B

GREEN, WILLIAM A.
THE CURRENT FEDERAL PROGRAM FOR RIVER BASIN PLANNING AND THE NEED FOR ECONOMIC ANALYSIS,
W68-01113 06B

GRINNELL, FRANK
THE MUNIMENTS OF TITLE OF MASSACHUSETTS TO HER SUBMERGED SEA LANDS,
W68-01395 06E

GROGAN, R. G.
OVERHEAD IRRIGATION ENCOURAGES WET-WEATHER PLANT DISEASES,
W68-01192 03F

GROVER, B. L.
EFFECTS OF SURFACE SEDIMENTS ON GROUNDWATER RECHARGE,
W68-01085 04B

GUREVICH, A YE
FILTRATION RATES OF GROUND WATERS,
W68-01136 02G

HADALA, P. F.
THE EFFECT OF PLACEMENT METHOD ON THE RESPONSE OF SOIL STRESS GAGES,
W68-01202 08D

HAHL, D. C.
DISSOLVED-MINERAL INFLOW TO GREAT SALT LAKE AND CHEMICAL CHARACTERISTICS OF THE SALT LAKE BRINE SUMMARY FOR WATER YEARS 1960, 1961, AND 1964,
W68-01249 02E

HAIMES, Y. Y.
IDENTIFICATION OF AQUIFER PARAMETERS BY DECOMPOSITION AND MULTILEVEL OPTIMIZATION,
W68-01047 02F

HALLER, GEORGE D.
MICHIGAN'S PURLOINED SHORELINES,
W68-01377 06E

HALL, WARREN A.
THE OPTIMUM MANAGEMENT OF GROUND WATER RESOURCES,
W68-01156 04B

HAMILTON, F. L.
EXPERIENCE WITH TRANSISTORISED PROTECTION IN BRITAIN,
W68-01215 08C

HAMILTON, L. J.
GEOLOGY AND GROUND-WATER RESOURCES OF THE LOWER BIGHORN VALLEY, MONTANA,
W68-01144 04B

HANSEN, ARNOLD J., JR.
AVAILABILITY OF GROUND WATER IN PARTS OF THE CAIRO AND BARLOW QUADRANGLES IN THE JACKSON PURCHASE REGION, KENTUCKY,
W68-01134 04B

HANTUSH, MAHDI S.
GROWTH AND DECAY OF GROUNDWATER-MOUNDS IN RESPONSE TO UNIFORM PERCOLATION,
W68-01083 04B

FLOW OF GROUNDWATER IN RELATIVELY THICK LEAKY AQUIFERS,
W68-01186 02F

HARLEMAN, DONALD R. F.
DISPERSION IN LAYERED POROUS MEDIA,
W68-01178 08D

HARTL, ROBERT D.
RIPARIAN RIGHTS - INLAND WATERS - RIGHT OF AN OWNER OF LAND ABUTTING ON INTER-TRACT LAKE TO THE USE OF THE ENTIRE SURFACE,
W68-01328 06E

HAUSER, V. L.
ARTIFICIAL GROUNDWATER RECHARGE THROUGH WELLS,
W68-01084 04B

HEARN, A. B.
RECLAMATION OF ANCIENT AGRICULTURAL SOILS IN WAHIDI, SOUTH ARABIA,
W68-01177 03C

HEATH, MILTON S., JR.
MODEL WATERSHED DISTRICT ACT,
W68-01327 04D

WATER USE LAW IN ACTION,
W68-01354 06E

HEBERT, D. J.
LAND SUBSIDENCE ALONG THE DELTA-MENDOTA CANAL, CALIFORNIA,
W68-01127 08A

HEIDEL, SUMNER G.
WATER RESOURCES OF THE SALISBURY AREA, MARYLAND,
W68-01141 03B

HEIN, JOHN L.
GEORGIA WATER LAW, USE AND CONTROL FACTORS,
W68-01402 06D

HELY, A. G.
HYDROLOGIC AND CLIMATOLOGIC DATA, 1967, SALT LAKE COUNTY, UTAH,
W68-01135 02A

HEM, JOHN D.
CHEMICAL GEOHYDROLOGY,
W68-01263 02K

HEPPTING, L. M.
USE OF MERCUROUS CHLORIDE TO RECOVER TRACE AMOUNTS OF GOLD FROM WATERS,
W68-01124 02K

HICKENLOOPER, I. J.
FLOODS IN THE MAYAGUEZ AREA OF PUERTIO RICO,
W68-01272 03B

HILEMAN, A. R.
1100-KV STATION AND LINE INSULATION DESIGN,
W68-01214 08C

HILLS, F. J.
PREHARVEST WATER STRESS FOR VALLEY SUGAR BEETS,
W68-01101 03F

HILL, DUANE W.
THE DYNAMICS OF PUBLIC ROLES IN THE SELECTION OF REVENUE SOURCES IN LOCAL WATER ADMINISTRATION,
W68-01061 06C

HOBBS, HAROLD W.
HYDROLOGIC DATA FOR EXPERIMENTAL AGRICULTURAL WATERSHEDS IN THE UNITED STATES, 1962,
W68-01121 04D

HOEKSTRA, PETER
EFFECTS OF TEMPERATURE AND PRESSURE ON UNFROZEN SOIL WATER,
W68-01264 02C

HOFFARD, STUART H.
FLOOD OF MARCH 24, 1967, KIHEI AND OLOWALU AREAS, ISLAND OF MAUI, HAWAII,
W68-01133 02E

HOFMANN, RENNER B.
GEODIMETER FAULT MOVEMENT INVESTIGATIONS IN CALIFORNIA,
W68-01224 08E

HOFMANN, WALTER
WHAT IS DROUGHT,
W68-01100 02E

HOMER, WILLIAM A.
NEW CONCEPTS FOR DESALTING BRACKISH WATER,
W68-01126 03A

HORR, C. A.
HYDROLOGIC AND CLIMATOLOGIC DATA, 1967, SALT LAKE COUNTY, UTAH,
W68-01135 02A

HOSNEDL, VACLAV
UNIDIRECTIONAL REVERSE HOME SYSTEM PUMP TURBINE,
W68-01225 08C

HOWE, CHARLES W.
THE IMPACT OF PRICE ON RESIDENTIAL WATER DEMAND AND ITS RELATION TO SYSTEM DESIGN AND PRICE STRUCTURE,
W68-01053 06D

HUDSON, J. D.
GROUND-WATER LEVELS IN NEW MEXICO, 1966,
W68-01266 04B

HUFF, F. A.
THE ADJUSTMENT OF RADAR ESTIMATES OF STORM MEAN RAINFALL WITH RAIN GAGE DATA,
W68-01180 02B

HUTCHINS, WELLS A.
BACKGROUND AND MODERN DEVELOPMENTS IN STATE WATER - RIGHTS LAW,
W68-01287 06E

HYATT, M. LEON
SUBCRITICAL FLOW OVER HIGHWAY EMBANKMENTS,
W68-01022 08B

ANALYSIS OF SUBMERGENCE IN FLOW MEASURING FLUMES,
W68-01123 08B

ISAEV, IU M.
INFLUENCE OF A METHOD OF AIR ADMISSION ON PRESSURE SURGES IN DRAFT TUBE MODELS OF AXIAL HYDRO-TURBINES,
W68-01230 08B

ITTIHADIEH, F. T.
INSECTICIDES IN TILE DRAINAGE EFFLUENT,
W68-01191 05G

JAMES, L. DOUGLAS
ECONOMIC ANALYSIS OF ALTERNATIVE FLOOD CONTROL MEASURES,
W68-01052 06F

JANOWITZ, G. S.
ON WAKES IN STRATIFIED FLUIDS,
W68-01040 08B

JANSEN, ARNOLD J., JR.
AVAILABILITY OF GROUND WATER IN THE OAKTON QUADRANGLE AND PART OF THE WOLF ISLAND QUADRANGLE IN JACKSON PURCHASE REGION, KENTUCKY,
W68-01117 04B

JENIK, J.
OBSERVATIONS ONMICROCLIMATE AND VEGETATION INTERRELATIONSHIPS ON THE ACCRA PLAINS (GHANA),
W68-01077 02D

JENNE, E. A.
USE OF MERCUROUS CHLORIDE TO RECOVER TRACE AMOUNTS OF GOLD FROM WATERS,
W68-01124 02K

JENSEN, BARTELL C.
OPTIMIZING CONJUNCTIVE USE OF SURFACE WATER AND GROUNDWATER,
W68-01155 02A

JODHA, H. R.
QUALITY OF GROUNDWATER FOR IRRIGATION IN AHOR DEVELOPMENT BLOCK, JALORE DISTRICT, WESTERN RAJASTHAN,
W68-01091 03C

JOHNSON, EDWIN L.
A STUDY IN THE ECONOMICS OF WATER QUALITY MANAGEMENT,
W68-01051 05G

W68-01165 05G

JOHNSON, KENNETH A.
SELECTIVE ION ELECTPODE SYSTEM FOR FLUORIDE ANALYSIS,
W68-01116 07B

JOHNSON, L. C.
SOURCES OF ERROR IN CALCULATING THE KINETIC ENERGY OF RAINFALL,
W68-01089 02B

JOHNSTON, RICHARD H.
U S GEOLOGICAL SURVEY TRACER STUDY AMARGOSA DESERT, NYE COUNTY, NEVADA--PART I EXPLORATORY DRILLING, TRACER WELL CONSTRUCTION AND TESTING AND PRELIMINARY FINDINGS,
W68-01248 04B

JOHNSTON, WILLIAM R.
INSECTICIDES IN TILE DRAINAGE EFFLUENT,
W68-01191 05G

JONES, D. M. A.
SOURCES OF ERROR IN CALCULATING THE KINETIC ENERGY OF RAINFALL,
W68-01089 02B

JONES, R. M.
SPECIES TRIALS IN THE SEMI-ARID SOUTHWEST OF NEW SOUTH WALES PART I--GRASSES AND LEGUMES,
W68-01074 03F

SPECIES TRIALS IN THE SEMI-ARID SOUTHWEST OF NEW SOUTH WALES PART II--NATIVE SHRUB TRIALS IN THE HAY DISTRICT,
W68-01075 03F

KARLIN, SAMUEL
OPTIMAL POLICY FOR HYDROELECTRIC OPERATIONS,
W68-01150 08C

KASER, ROLLAND F.
USE OF MODERN EQUIPMENT AND TECHNIQUES IN THE PLANNING AND DEVELOPMENT OF WATER RESOURCES,
W68-01160 06A

KEPPEL, ROBERT V.
HYDROGRAPHS OF EPHEMERAL STREAMS IN THE SOUTHWEST,
W68-01092 04A

KERNER, H.
STRESSES IN TRANSMISSION LINE CONDUCTORS NEAR THE SUSPENSION CLAMP,
W68-01213 08C

KLIKOFF, LIONEL G.
MOISTURE STRESS IN A VEGETATIONAL CONTINUUM IN THE SONORAN DESERT,
W68-01103 03F

KNEESE, ALLEN
THE ROLE OF ECONOMIC EVALUATION IN PLANNING FOR WATER RESOURCE DEVELOPMENT,
W68-01332 06B

KNETSCH, JACK L.
COMPARISONS OF METHODS FOR RECREATION EVALUATION,
W68-01063 06B

KNISEL, WALTER G., JR.
FIELD AND LABORATORY EXPERIMENTAL APPROACHES,
W68-01233 02E

KOFORD, CARL B.

PERUVIAN DESERT MICE WATER INDEPENDENCE, COMPETITION, AND BREEDING CYCLE NEAR THE EQUATOR,
W68-01081 02I

KOHOUT, F. A.
GROUNDWATER FLOW AND THE GEOTHERMAL REGIME OF THE FLORIDIAN PLATEAU,
W68-01270 02F

KOLP, DON G.
EFFECT OF TALLOW ALCOHOL ADDED TO SOIL ON THE TENSION, FLOW, AND EVAPORATION OF SOIL WATER,
W68-01173 02G

KONIZESKI, R. L.
GEOLOGY AND GROUND WATER RESOURCES OF THE KALISPELL VALLEY, NORTHWESTERN MONTANA,
W68-01265 04B

KOPPL, G.
TRANSIENT RECOVERY VOLTAGE CAUSED BY DIFFERENT SWITCHING OPERATIONS IN HV NETWORKS CONTAINING UNDERGROUND CABLES,
W68-01211 08C

KOVALEV, N. N.
HYDRAULIC TURBINE CONSTRUCTION IN THE USSR,
W68-01229 08C

KRASNIKOV, N. D.
APPLICATION OF SEISMIC EXPLORATION METHODS IN ENGINEERING-GEOLOGICAL INVESTIGATIONS,
W68-01223 08E

KRAUSE, FRANK P.
EFFECT OF TALLOW ALCOHOL ADDED TO SOIL ON THE TENSION, FLOW, AND EVAPORATION OF SOIL WATER,
W68-01173 02G

KRUTILLA, JOHN V.
THE COLUMBIA RIVER TREATY,
W68-01064 06E

KURTZ, MAXINE
URBAN DRAINAGE ASPECTS OF PUBLIC AND PRIVATE LIABILITY,
W68-01335 04C

LADNER, GROVER C.
PROTECTING OUR WATER RESOURCES,
W68-01345 03F

LAKSHMANA RAO, N. S.
SOME STUDIES ON NEW TYPES OF FRICTION BLOCKS,
W68-01258 08B

LAMBERT, T. W.
AVAILABILITY OF GROUND WATER IN THE HICKMAN QUADRANGLE, KENTUCKY-MISSOURI-TENNESSEE,
W68-01122 03B

AVAILABILITY OF GROUND WATER IN THE PARTS OF THE WICKLIFFE AND WICKLIFFE NW QUADRANGLES IN JACKSON PURCHASE REGION, KENTUCKY,
W68-01132 04B

LANE, JOHN E.
THE EFFECTS OF VARYING LAND AND WATER USE ON STREAMFLOW REGIMEN,
W68-01261 04C

LANGE, WILLY
EFFECT OF TALLOW ALCOHOL ADDED TO SOIL ON THE TENSION, FLOW, AND EVAPORATION OF SOIL WATER,
W68-01173 02G

LAWRENCE, J. M.
FACTORS AFFECTING PERSISTENCE AND INACTIVATION OF DIQUAT AND PARAQUAT,
W68-01274 05B

PHOTOCHEMICAL DECOMPOSITION OF DIQUAT AND PARAQUAT,
W68-01276 05A

THE EFFECT OF DICHLOBENIL AND DICAMBA ON NODAL TISSUES OF ALLIGATORWEED,
W68-01278 04A

PERSISTENCE OF DIQUAT, PARAQUAT, AND 2,4-DBEE WHEN USED FOR EURASIAN WATERMILFOIL CONTROL,
W68-01279 04A

EFFECTIVENESS OF HERBICIDAL COMBINATIONS ON ALLIGATORWEED GROWING IN FLOWING WATER,
W68-01280 04A

LAWSON, G. W.
OBSERVATIONS ONMICROCLIMATE AND VEGETATION INTERRELATIONSHIPS ON THE ACCRA PLAINS (GHANA),
W68-01077 02D

LEONARD, ROBERT L.
INTEGRATING MANAGEMENT OF GROUND AND IMPORTED WATER IN LOS ANGELES COUNTY,
W68-01193 03D

LEVI, ENZO
ENERGY ABSORPTION IN HIGH-VELOCITY CURRENTS,
W68-01221 08B

LIAKOPOULOS, ARISTIDES
THEORETICAL PREDICTION OF EVAPORATION LOSSES FROM GROUNDWATER,
W68-01172 02D

LIEBMAN, JON C.
BALAS ALGORITHM FOR ZONED UNIFORM TREATMENT,
W68-01161 05D

LIGON, RODDEY M.
LEGAL BASIS FOR WATER POLLUTION CONTROL,
W68-01352 06E

LINAWEAVER, F. P., JR.
THE IMPACT OF PRICE ON RESIDENTIAL WATER DEMAND AND ITS RELATION TO SYSTEM DESIGN AND PRICE STRUCTURE,
W68-01053 06D

LINDHOLM, GERALD F.
GEOLOGY AND WATER RESOURCES OF THE HIBBING AREA, NORTHEASTERN MINNESOTA,
W68-01267 04B

LIN, SHUN-DAR
PILOT PLANT STUDIES ON THE ANAEROBIC TREATMENT OF TANNERY EFFLUENTS,
W68-01125 05D

LITTLE, A. L.
MANGLA INSTRUMENTATION,
W68-01239 07B

LITTLE, E. C. S.
THE CONTROL OF WATER WEEDS,
W68-01235 04A

LLOYD, ORVILLE B., JR.
GROUND-WATER RESOURCES OF CHOWAN COUNTY, NORTH CAROLINA,
W68-01024 04B

LONDE, P.
DIFFERENCES BETWEEN EUROPEAN AND AMERICAN PRACTICE IN THE USE OF GROUT CURTAINS IN ROCK FOUNDATIONS,
W68-01210 08E

LONG, WILBUR E.
WATER POLLUTION CONTROL IN NORTH CAROLINA,
W68-01353 06E

LOOMIS, R. S.
PREHARVEST WATER STRESS FOR VALLEY SUGAR BEETS,
W68-01101 03F

LOTSPEICH, F. B.
ARTIFICIAL GROUNDWATER RECHARGE THROUGH WELLS,
W68-01084 04B

LOUCKS, DANIEL P.
COMPUTER MODELS FOR RESERVOIR REGULATION,
W68-01154 06A

LINEAR PROGRAMMING MODELS FOR WATER POLLUTION CONTROL,
W68-01159 05G

LOUCKS, D. P.
PROBABILISTIC MODELS FOR PREDICTING STREAM QUALITY,
W68-01149 05F

A COMMENT ON OPTIMIZATION METHODS FOR BRANCHING MULTISTAGE WATER RESOURCE SYSTEMS,
W68-01158 06A

LOW, PHILIP F.
EFFECTS OF TEMPERATURE AND PRESSURE ON UNFROZEN SOIL WATER,
W68-01264 02C

LUTHIN, JAMES N.
DEPTH OF DRAINAGE IN IRRIGATED AREAS,
W68-01231 04A

LYLES, LEON
LANDFORMING FOR LEACHING OF SALINE SOILS IN A NONIRRIGATED AREA,
W68-01087 03F

LYNN, WALTER R.
LINEAR PROGRAMMING MODELS FOR WATER POLLUTION CONTROL,
W68-01159 05G

LYNN, W. R.
PROBABILISTIC MODELS FOR PREDICTING STREAM QUALITY,
W68-01149 05F

MADDOCK, THOMAS, JR.
VARIATIONS OF THE HYDRAULIC ROUGHNESS OF ALLUVIAL CHANNELS,
W68-01273 08B

MAKLAD, FATHY M. A.
A PRELIMINARY STUDY ON THE EFFECT OF ARTIFICIALLY CREATED LAYERS IN SANDY SOILS ON YIELD OF ALFALFA,
W68-01099 03F

MALLIK, A. K.
ARID-ZONE AGROMETEOROLOGY IN INDIA,
W68-01171 02B

MALLORY, EDWARD C., JR.
DETERMINATION OF MOLYBDENUM IN FRESH WATERS - A COMPARISON OF METHODS,
W68-01046 02K

MALONEY, FRANK E.
EASTERN LAWS CONCERNING MINIMUM STREAM FLOWS AND IMPOUNDMENTS,

W68-01357 06E

MANHEIM, FRANK T.
A FLEXIBLE COMPUTER PROGRAM FOR EVALUATION OF EMISSION SPECTROMETRIC DATA,
W68-01252 07C

MARKS, DAVID H.
BALAS ALGORITHM FOR ZONED UNIFORM TREATMENT,
W68-01161 05D

MARQUIS, ROBERT H.
STATUTES FOR ADMINISTERING WATER USE IN THE SOUTHEAST,
W68-01350 06E

MARSTON, FRANK A.
DECISIONS RELATING TO DISTRIBUTION OF PUBLIC WATER SUPPLIES,
W68-01374 03D

MARTIN, ROSCOE C.
WATER RESOURCES LAW,
W68-01324 06E

MARTZ, CLYDE O.
WATER MUSHROOMING POPULATIONS,
W68-01344 06D

MARTZ, C. O.
CLASSES OF WATER AND CHARACTER OF WATER RIGHTS AND USES - SECTION 51 WATER-LAW DOCTRINE,
W68-01290 06E

CLASSES OF WATER AND CHARACTER OF WATER RIGHTS AND USES - SECTION 52 THE PRINCIPAL CATEGORIES OF SURFACE AND GROUND WATERS,
W68-01291 06E

CLASSES OF WATER AND CHARACTER OF WATER RIGHTS AND USES - SECTION 53 NATURE OF PROPERTY RIGHTS IN WATER,
W68-01292 06E

CLASSES OF WATER AND CHARACTER OF WATER RIGHTS AND USES - SECTION 54 BENEFICIAL AND REASONABLE USES OF WATER,
W68-01293 06E

CLASSES OF WATER AND CHARACTER OF WATER RIGHTS AND USES - SECTION 55 QUANTITY AND QUALITY OF SUPPLY,
W68-01294 06E

MASCH, FRANK D.
GRAIN SIZE DISTRIBUTION AND ITS EFFECT ON THE PERMEABILITY OF UNCONSOLIDATED SANDS,
W68-01175 02G

MASRUR, ANWAR
CRIB DAMS FOR CONTROL OF SEDIMENT AND STREAMBED EROSION AND THEIR SUITABILITY FOR CONDITIONS IN PAKISTAN,
W68-01179 08D

MATLOCK, W. G.
RAINFALL COLLECTION FOR DOMESTIC WATER SUPPLIES,
W68-01079 03F

MAVLYANOV, G.
THE TASHKENT EARTHQUAKE,
W68-01205 08E

MAZAHERI, A.
EFFECT OF SOIL MOISTURE DEPLETION ON CROP YIELD AND STOMATAL INFILTRATION,
W68-01189 03F

MAZURKIEWICZ, BOLESLAW
ANALYSIS OF THE STABILITY OF COFFERDAMS WITH DOUBLE SHEET WALLS ACCORDING TO FIELD AND MODEL TESTS,
W68-01228 08A

MCCONNELL, WILLIAM J.
LIMNOLOGICAL EFFECTS OF ORGANIC EXTRACTS OF LITTER IN A SOUTHWESTERN IMPOUNDMENT,
W68-01093 02H

MCGARY, K. H.
WATER LEVEL PROBE,
W68-01021 07B

MCGUIRE, C. B.
A SOCIALLY OPTIMUM PRICING POLICY FOR A PUBLIC WATER AGENCY,
W68-01057 06C

MCINTOSH, T. H.
BOUNDARY FLOW IN LABORATORY PERMEAMETERS USED TO STIMULATE RECHARGE BY CYCLIC WATER SPREADING,
W68-01120 02G

MCKEAN, ROLAND N.
THE USE OF SHADOW PRICES,
W68-01065 06B

MCKINNON, J. P.
1100-KV STATION AND LINE INSULATION DESIGN,
W68-01214 08C

MCMURTREY, R. G.
GEOLOGY AND GROUND WATER RESOURCES OF THE KALISPELL VALLEY, NORTHWESTERN MONTANA,
W68-01265 04B

MCPHERSON, W. K.
CAN WATER BE ALLOCATED BY COMPETITIVE PRICES,
W68-01383 06C

MCQUEEN, I. S.
GEOGRAPHIC DISTRIBUTION AND FACTORS AFFECTING THE DISTRIBUTION OF SALT DESERT SHRUBS IN THE UNITED STATES,
W68-01176 02I

MELNIK, V. G.
STABILITY OF DAMS ERECTED OF LOCAL MATERIALS UNDER DYNAMIC LOADS,
W68-01208 08D

MILLER, R. F.
GEOGRAPHIC DISTRIBUTION AND FACTORS AFFECTING THE DISTRIBUTION OF SALT DESERT SHRUBS IN THE UNITED STATES,
W68-01176 02I

MILLIGAN, JAMES H.
OPTIMIZING CONJUNCTIVE USE OF SURFACE WATER AND GROUNDWATER,
W68-01155 02A

MILLIMAN, JEROME W.
COMMONALITY, THE PRICE SYSTEM, AND USE OF WATER SUPPLIES,
W68-01399 06C

MILLIMAN, J. W.
WATER LAW AND PRIVATE DECISION-MAKING A CRITIQUE,
W68-01397 06D

WATER LAW AND DECISION-MAKING A CRITIQUE,
W68-01400 06C

MINCKLEY, W. L.
SOUTHWESTERN FISHES AND THE ENIGMA OF 'ENDANGERED SPECIES',
W68-01102 06G

MISRA, D. K.
RECLAMATION OF THE RAJPUTANA DESERT,
W68-01242 04A

MOWER, R. W.
HYDROLOGIC AND CLIMATOLOGIC DATA, 1967, SALT LAKE COUNTY, UTAH,
W68-01135 02A

MUIRHEAD, W. A.
SPECIES TRIALS IN THE SEMI-ARID SOUTHWEST OF NEW SOUTH WALES PART I--GRASSES AND LEGUMES,
W68-01074 03F

SPECIES TRIALS IN THE SEMI-ARID SOUTHWEST OF NEW SOUTH WALES PART II--NATIVE SHRUB TRIALS IN THE HAY DISTRICT,
W68-01075 03F

MURPHY, EARL FINBAR
A SHORT COURSE ON WATER LAW FOR THE EASTERN UNITED STATES,
W68-01368 06E

MURPHY, EARL F.
WATER PURITY A STUDY IN LEGAL CONTROL OF NATURAL RESOURCES,
W68-01360 05G

W68-01361 06E

BASES OF RESOURCE REGULATION,
W68-01362 06E

CHANGES IN RESOURCE MANAGEMENT,
W68-01363 06E

TRANSITION TO CENTRAL ADMINISTRATIVE CONTROL,
W68-01364 06E

DEVELOPMENT OF CENTRAL ADMINISTRATING CONTROL,
W68-01365 06E

OPERATION OF THE STATE CENTRAL ADMINISTRATIVE AGENCY,
W68-01366 06E

ENGLISH WATER LAW DOCTRINES BEFORE 1400,
W68-01379 06E

NAKABORI, H.
ULTRASONIC METHOD OF FLOW MEASUREMENT,
W68-01240 07B

NANKEN, L. N.
RELATIVE TURGIDITY TECHNIQUE FOR SCHEDULING COTTON (GOSSYPIUM BIRSUTUM) IRRIGATION,
W68-01066 03F

INFLUENCES OF PLANT MOISTURE STRESS, SOLAR RADIATION, AND AIR TEMPERATURE ON COTTON LEAF TEMPERATURE,
W68-01071 03F

NECHLEBA, MIROSLAV
UNIDIRECTIONAL REVERSE HOME SYSTEM PUMP TURBINE,
W68-01225 08C

NEGI, N. S.
PHOTOCHEMICAL DECOMPOSITION OF DIQUAT AND PARAQUAT,
W68-01276 05A

NICHIPOROVITCH, A. A.
STABILITY OF DAMS ERECTED OF LOCAL MATERIALS UNDER DYNAMIC LOADS,
W68-01208 08D

NIELD, D. A.
ONSET OF THERMOHALINE CONVECTION IN A POROUS MEDIUM,
W68-01038 08B

NOBE, KENNETH C.
THE ROLE OF ECONOMIC EVALUATION IN PLANNING FOR WATER RESOURCE DEVELOPMENT,
W68-01332 06B

NORAGAARD, RICHARD B.
STREAMFLOW FLUCTUATION, BAR ROUGHNESS, AND BED LOAD MOVEMENT A HYPOTHESIS,
W68-01044 02E

NORMAN, W. E.
BIG-HOLE DRILLING IS COMING OF AGE UNDERGROUND,
W68-01196 08H

NYMAN, DALE J.
FLOW PATTERN AND RELATED CHEMICAL QUALITY OF GROUND WATER IN THE '500-FOOT' SAND IN THE MEMPHIS AREA, TENNESSEE,
W68-01130 02F

OGDEN, P. R.
TIME OF FERTILIZER APPLICATION ON DESERT GRASSLANDS,
W68-01068 03F

OGIL'VI, N. A.
GROUNDWATER SEEPAGE RATES,
W68-01237 02F

OKUN, DANIEL A.
THE HIERARCHY OF WATER QUALITY,
W68-01257 03D

OTTE, ROBERT C.
STATE DISTRICT LAWS AS THEY AFFECT WATERSHED DEVELOPMENT,
W68-01326 04D

ECONOMIC EVALUATION OF THE SMALL WATERSHED PROGRAM,
W68-01378 04D

OWNBEY, C. R.
THE GREAT LAKES WATER RESOURCE,
W68-01305 05C

O'BRIEN, JOHN L.
HIGHWAYS - FLOOD DAMAGE - PROPOSED MODIFICATION OF COMMON ENEMY RULE,
W68-01339 04C

PAINE, KAY
A FLEXIBLE COMPUTER PROGRAM FOR EVALUATION OF EMISSION SPECTROMETRIC DATA,
W68-01252 07C

PARIKH, SHAILENDRA C.
LINEAR DYNAMIC DECOMPOSITION PROGRAMMING APPROACH TO LONG-RANGE OPTIMIZATION OF NORTHERN CALIFORNIA WATER RESOURCES SYSTEM, PART I DETERMINISTIC HYDROLOGY,
W68-01152 06A

PARSONS, R. F.
EDAPHIC RANGE AND COHABITATION OF SOME MALLEE EUCALYPTS IN SOUTH-EASTERN AUSTRALIA,
W68-01078 02I

PATE, D. A.
CHEMICALS MAY CONTROL STUBBORN ALLIGATORWEED,
W68-01277 04A

THE EFFECT OF DICHLOBENIL AND DICAMBA ON NODAL TISSUES OF ALLIGATORWEED,
W68-01278 04A

ABSORPTION, TRANSLOCATION, AND METABOLISM OF C-14-LABELED DICHLOBENIL,
W68-01283 04A

PATRICKSON, J. B.
EXPERIENCE WITH TRANSISTORISED PROTECTION IN BRITAIN,
W68-01215 08C

PATTERSON, JAMES L.
MAGNITUDE AND FREQUENCY OF FLOODS IN THE UNITED STATES PART 5. HUDSON BAY AND UPPER MISSISSIPPI RIVER BASIN,
W68-01023 02E

PAULSON, Q. F.
GEOLOGY AND GROUND-WATER RESOURCES OF THE LOWER BIGHORN VALLEY, MONTANA,
W68-01144 04B

PAUSZEK, F. H.
STREAMS IN DUTCHESS COUNTY, NEW YORK--THEIR FLOW CHARACTERISTICS AND WATER QUALITY IN RELATION TO WATER PROBLEMS,
W68-01042 04A

PEARL, IRWIN A.
WASTE PRODUCT USE HELPS PAPER INDUSTRY CONTROL POLLUTION,
W68-01255 05B

PERRINE, R. L.
IDENTIFICATION OF AQUIFER PARAMETERS BY DECOMPOSITION AND MULTILEVEL OPTIMIZATION,
W68-01047 02F

PETERSON, DEAN F.
GROUND WATER IN ECONOMIC DEVELOPMENT,
W68-01090 03F

PETERS, JOHN H.
WATER CONSERVATION BY RECLAMATION AND RECHARGE,
W68-01048 05D

PETROV, L. A.
ROD REINFORCEMENT OF TUNNEL TYPE EXCAVATIONS,
W68-01201 08A

PHILIPPS, W.
STRESSES IN TRANSMISSION LINE CONDUCTORS NEAR THE SUSPENSION CLAMP,
W68-01213 08C

PILKEY, ORRIN H.
SEDIMENTATION IN ONSLOW BAY (IN GUIDEBOOK FOR FIELD EXCURSIONS, GEOLOGICAL SOCIETY OF AMERICA, SOUTHEASTERN SECTION),
W68-01262 02L

PIPER, ARTHUR M.
POTENTIAL APPLICATIONS OF NUCLEAR EXPLOSIVES IN DEVELOPMENT AND MANAGEMENT OF WATER RESOURCES--PRELIMINARY CANVASS OF THE GROUND-WATER ENVIRONMENT,
W68-01142 08H

POSTON, H. W.
THE GREAT LAKES WATER RESOURCE,
W68-01305 05C

PRAKASAM, T. B. S.
ADAPTATION BY MICROBIAL POPULATIONS,
W68-01168 05D

PRASAD, RAM
RECLAMATION OF THE RAJPUTANA DESERT,
W68-01242 04A

PROKOPOVICH, N. P.
LAND SUBSIDENCE ALONG THE DELTA-MENDOTA CANAL, CALIFORNIA,
W68-01127 08A

RAATS, P. A. C.
DYNAMICALLY SIMILAR MOTION OF TWO MISCIBLE CONSTITUENTS IN POROUS MEDIUMS,
W68-01031 02G

RABCEWICZ, L. V.
NEW AUSTRIAN TUNNEL CONSTRUCTION METHOD,
W68-01197 08H

RADWAN, MOHAMED
A PRELIMINARY STUDY ON THE EFFECT OF ARTIFICIALLY CREATED LAYERS IN SANDY SOILS ON YIELD OF ALFALFA,
W68-01099 03F

RAMAMOORTY, M.
HIGH SPEED PROTECTION OF POWER SYSTEMS BASED ON IMPROVED POWER SYSTEM MODELS,
W68-01216 08C

RANTZ, S. E.
WHAT IS DROUGHT,
W68-01100 02E

RECHARD, PAUL A.
THE EFFECTS OF VARYING LAND AND WATER USE ON STREAMFLOW REGIMEN,
W68-01261 04C

RENARD, KENNETH G.
HYDROGRAPHS OF EPHEMERAL STREAMS IN THE SOUTHWEST,
W68-01092 04A

REVELLE, CHARLES S.
LINEAR PROGRAMMING MODELS FOR WATER POLLUTION CONTROL,
W68-01159 05G

REYNOLDS, J. H.
SUBMARINE PIPELINES,
W68-01199 08A

RICHARD, MELVIN J.
TIDELANDS AND RIPARIAN RIGHTS IN FLORIDA,
W68-01376 06E

RICKLES, ROBERT N.
WASTE RECOVERY AND POLLUTION ABATEMENT,
W68-01322 05F

RIJKS, D. A.
RECLAMATION OF ANCIENT AGRICULTURAL SOILS IN WAHIDI, SOUTH ARABIA,
W68-01177 03C

ROBERTSON, S. D. T.
HIGH SPEED PROTECTION OF POWER SYSTEMS BASED ON IMPROVED POWER SYSTEM MODELS,
W68-01216 08C

ROBINSON, FRANK
DEPTH OF DRAINAGE IN IRRIGATED AREAS,
W68-01231 04A

ROBINSON, FRANK E.
FACTORS AFFECTING THE EMERGENCE OF SUGAR BEETS IN AN IRRIGATED DESERT ENVIRONMENT,
W68-01187 03F

ROBINSON, G. B., JR.
SELECTED HYDROLOGIC DATA, SAN PITCH RIVER DRAINAGE BASIN, UTAH,
W68-01146 03B

RODRIQUEZ-KABANA, R.
METABOLISM OF FLUOMETURON BY SEVERAL BIOLOGICAL SYSTEMS,
W68-01281 05A

ROEHM, LOUIS H.
STRUCTURAL BEHAVIOR MEASUREMENTS FOR PENSTOCKS THROUGH CONCRETE DAMS HUNGRY HORSE AND CANYON FERRY DAMS,
W68-01222 08A

ROGERS, J. S.
SOURCES OF ERROR IN CALCULATING THE KINETIC ENERGY OF RAINFALL,
W68-01089 02B

ROGERS, R. L.
METABOLISM OF FLUOMETURON BY SEVERAL BIOLOGICAL SYSTEMS,
W68-01281 05A

ROMANOFF, MELVIN
PERFORMANCE OF DUCTILE-IRON PIPE IN SOILS,
W68-01194 08G

ROSEN, MILTON J.
MODIFICATION OF THE PERMEABILITY OF LOESS BY ELECTROLYTES,
W68-01098 02G

ROSE, JOHN L.
WATER CONSERVATION BY RECLAMATION AND RECHARGE,
W68-01048 05D

ROTHE, J. P.
FILL A LAKE, START AN EARTHQUAKE,
W68-01220 08E

ROWAN, J. N.
EDAPHIC RANGE AND COHABITATION OF SOME MALLEE EUCALYPTS IN SOUTH-EASTERN AUSTRALIA,
W68-01078 02I

SAKSENA, R. K.
QUALITY OF GROUNDWATER FOR IRRIGATION IN AHOR DEVELOPMENT BLOCK, JALORE DISTRICT, WESTERN RAJASTHAN,
W68-01091 03C

SALIM, M. H.
TRANSPIRATION PATTERNS OF WHEAT, BARLEY AND OAT SEEDLINGS UNDER VARYING CONDITIONS OF SOIL MOISTURE,
W68-01190 03F

SANDERS, WILLIAM A.
REAL PROPERTY - SURFACE WATERS - COMMON ENEMY RULE AMPLIFIED,
W68-01391 06E

SANTEFORD, HENRY S., JR.
CHARACTERISTICS OF INTERFACE FLOW IN SUBSURFACE DISPOSAL SYSTEMS,
W68-01245 05G

SAPEGIN, D. D.
ROD REINFORCEMENT OF TUNNEL TYPE EXCAVATIONS,
W68-01201 08A

SATA, SHO
TAX PROBLEMS RELATING TO WATER RIGHTS AND WATERWORKS - DIV A AND DIV B INTRODUCTION AND PROPERTY TAX,
W68-01296 06E

SATO, SHO
TAX PROBLEMS RELATING TO WATER RIGHTS AND WATERWORKS - DIV C SPECIAL TAXES ON WATER AND ELECTRIC COMPANIES - DIV D FEDERAL INCOME TAX PROBLEMS RELATING TO WATER RIGHTS AND H2O WKS,
W68-01297 06E

SAUCIER, JOHN W.
HOW TO OPERATE 'PACKAGE' WASTEWATER TREATMENT PLANTS,
W68-01020 05D

SAYRE, WILLIAM W.
DISPERSION OF MASS IN OPEN-CHANNEL FLOW,
W68-01129 08B

SCATTER, D. R.
DYNAMICALLY SIMILAR MOTION OF TWO MISCIBLE CONSTITUENTS IN POROUS MEDIUMS,
W68-01031 02G

SCHAAKE, JOHN C., JR.
SIMULATION OF A NATIONAL FLOOD INSURANCE FUND,
W68-01062 06F

SCHNEIDER, WILLIAM J.
WATER DATA FOR METROPOLITAN AREAS,
W68-01027 07A

SCHUBEL, J. R.
SUSPENDED SEDIMENT OF THE NORTHERN CHESAPEAKE BAY,
W68-01268 02L

SCOTT, JOHN E. S.
NAVIGABLE WATERS - RIGHTS OF RIPARIAN OWNER HELD NOT TO INCLUDE THE RIGHT TO CONSTRUCT A PERMANENT DEEP WATER DOCK INTO LAKE HURON,
W68-01329 04C

SELLERS, J. B.
ROCK MECHANICS INSTRUMENTATION IN TUNNELS,
W68-01241 07B

SHALOWITZ, AARON L.
BOUNDARY PROBLEMS RAISED BY THE SUBMERGED LANDS ACT,
W68-01394 06E

SHAMIR, URI Y.
DISPERSION IN LAYERED POROUS MEDIA,
W68-01178 08D

SHANMUGAN, S.
RETARDATION OF EVAPORATION FROM OPEN WATER STORAGES,
W68-02256 03B

SHANNONHOUSE, ROYAL G.
COMMON LAW RULES REGARDING THE USE OF SURFACE AND GROUND WATER IN THE SOUTHEASTERN STATES,
W68-01349 06E

SHARMA, M. L.
QUALITY OF GROUNDWATER FOR IRRIGATION IN AHOR DEVELOPMENT BLOCK, JALORE DISTRICT, WESTERN RAJASTHAN,
W68-01091 03C

SHARPE, CLIFFORD A.
WATER QUALITY DEGRADATION BY WOOD BARK POLLUTANTS,
W68-01269 05C

SHAW, RICHARD J.
NATURAL RECHARGE IN TUCSON BASIN,
W68-01080 04B

SHAW, R. J.
RAINFALL COLLECTION FOR DOMESTIC WATER SUPPLIES,
W68-01079 03F

SHEPHARD, RONALD W.
LINEAR DYNAMIC DECOMPOSITION PROGRAMMING APPROACH TO LONG-RANGE OPTIMIZATION OF NORTHERN CALIFORNIA WATER RESOURCES SYSTEM, PART I DETERMINISTIC HYDROLOGY,
W68-01152 06A

SHJEFLO, JELMER B.
EVAPOTRANSPIRATION AND THE WATER BUDGET OF PRAIRIE POTHOLES IN NORTH DAKOTA,
W68-01043 02D

SKOGERBOE, GAYLORD V.
SUBCRITICAL FLOW OVER HIGHWAY EMBANKMENTS,
W68-01022 08B

ANALYSIS OF SUBMERGENCE IN FLOW MEASURING FLUMES,
W68-01123 08B

SKUE, A. R.
DESIGNING THE APPROACH CHANNEL FOR SHAFT SPILLWAYS,
W68-01226 08B

SLATYER, R. O.
SOME PHYSICAL ASPECTS OF INTERNAL CONTROL OF LEAF TRANSPIRATION,
W68-01109 02D

SLEIGH, WILLIAM B., JR.
THE MUNIMENTS OF TITLE OF MASSACHUSETTS TO HER SUBMERGED SEA LANDS,
W68-01395 06E

SLEMON, G. R.
HIGH SPEED PROTECTION OF POWER SYSTEMS BASED ON IMPROVED POWER SYSTEM MODELS,
W68-01216 08C

SNYDER, W. C.
OVERHEAD IRRIGATION ENCOURAGES WET-WEATHER PLANT DISEASES,
W68-01192 03F

SPROUL, OTIS J.
WATER QUALITY DEGRADATION BY WOOD BARK POLLUTANTS,
W68-01269 05C

STALLMAN, ROBERT W.
EXAMPLES OF RECENT ADVANCES IN ANALYTICAL TECHNIQUES FOR EVALUATING AQUIFERS,
W68-01118 07A

STARR, WARREN A.
MULTIPLE LAND USE MANAGEMENT,
W68-01319 06B

STEELE, HARRY
THE IMPORTANCE OF RESEARCH AND PLANNING IN WATER RESOURCE DEVELOPMENT,
W68-01114 06B

STEINBERG, RAYA
A STATISTICAL INVESTIGATION OF PERSISTENCE IN THE ISRAELI ARTIFICIAL RAINFALL STIMULATION EXPERIMENT,
W68-01094 03B

STEIN, MURRAY
REGULATORY ASPECTS OF FEDERAL POLLUTION CONTROL,
W68-01302 05G

STEOVENER, HERBERT H.
WATER RESOURCES ALLOCATION, EXTRAMARKET VALUES, AND MARKET CRITERIA A SUGGESTED APPROACH,
W68-01111 06B

STEVENS, JOSEPH B.
RECREATION BENEFITS FROM WATER POLLUTION CONTROL A FURTHER NOTE ON BENEFIT EVALUATION,
W68-01055 06B

STOCKTON, CHARLES W.
CONDITIONAL PROBABILITY OF OCCURRENCE FOR VARIATIONS IN CLIMATE BASED ON WIDTHS OF ANNUAL TREE RINGS IN ARIZONA,
W68-01251 02B

STONE, ALBERT W.
PUBLIC RIGHTS IN WATER USES AND PRIVATE RIGHTS IN LAND ADJACENT TO WATER - DIV A TRADITIONAL RIGHTS OF THE PUBLIC IN WATER USES,
W68-01288 06E

PUBLIC RIGHTS IN WATER USES AND PRIVATE RIGHTS IN LAND ADJACENT TO WATER - DIVISION B PRIVATE RIGHTS IN LAND ADJACENT TO WATER,
W68-01289 06E

THE HOOVER REPORTS ON WATER RESOURCES AND POWER -- A COMMENTARY,
W68-01311 06B

STRAWN, KIRK
RESISTANCE OF TEXAS SALT - AND FRESHWATER - MARSH FISHES TO HEAT DEATH AT VARIOUS SALINITIES,
W68-01073 05C

STROEHLEIN, J. L.
TIME OF FERTILIZER APPLICATION ON DESERT GRASSLANDS,
W68-01068 03F

STUBBS, DONALD G.
THE RIGHTS OF A RIPARIAN LANDOWNER IN MISSOURI,
W68-01390 06E

SUMSION, CARLTON T.
SUMMARY OF THE GEOLOGY AND GROUND-WATER RESOURCES OF PITT COUNTY, NORTH CAROLINA,
W68-01147 04B

SURYANARAYANA RAO, H. S.
SOME STUDIES ON NEW TYPES OF FRICTION BLOCKS,
W68-01258 08B

SUTHERLAND, ALEX J.
GROWTH OF SPECTRAL COMPONENTS IN A WIND-GENERATED WAVE TRAIN,
W68-01030 08B

SUZUKI, H.
ULTRASONIC METHOD OF FLOW MEASUREMENT,
W68-01240 07B

SWARZENSKI, WOLFGANG V.
FRESH AND SALINE GROUND-WATER ZONES IN THE PUNJAB REGION, WEST PAKISTAN,
W68-01039 03C

TAI, TEIN-LIE
THEORETICAL STUDIES OF CRATERING MECHANISMS AFFECTING THE STABILITY OF CRATERED SLOPES,
W68-01195 08D

TECLAFF, LUDWIK A.
PRIVATE WATER RIGHTS IN FRANCE AND IN THE EASTERN UNITED STATES,
W68-01320 06E

TELLIER, L. S.
RIGHTS AND DUTIES OF OWNERS INTER SE WITH RESPECT TO UPKEEP AND REPAIR OF WATER EASEMENT,
W68-01375 06E

THOMANN, ROBERT V.
USE OF SYSTEMS ANALYSIS IN ESTUARINE WATER POLLUTION CONTROL,
W68-01162 05G

THOMAS, HAROLD A., JR.
THE ANIMAL FARM A MATHEMATICAL MODEL FOR THE DISCUSSION OF SOCIAL STANDARDS FOR CONTROL OF THE ENVIRONMENT,
W68-01157 06B

THOMPSON, GEOFFRY
A FLEXIBLE COMPUTER PROGRAM FOR EVALUATION OF EMISSION SPECTROMETRIC DATA,
W68-01252 07C

THOMPSON, J. R.
EFFECT OF GRAZING ON INFILTRATION IN A WESTERN WATERSHED,
W68-01105 04D

THOMPSON, SAMUEL A.
MISSISSIPPI WATER-USE LAWS AND ADMINISTRATION,
W68-01351 06E

THOM, H. C. S.
NEW DISTRIBUTIONS OF EXTREME WINDS IN THE UNITED STATES,
W68-01200 07A

TIMMONS, JOHN F.
INTEGRATING FARM AND WATERSHED PLANNING IN SOIL AND WATER RESOURCE MANAGEMENT,
W68-01234 03F

TODD, GLENN W.
EFFECTS OF REPEATED DROUGHT PERIODS ON PHOTOSYNTHESIS AND SURVIVAL OF CEREAL SEEDLINGS,
W68-01188 03F

TRANSPIRATION PATTERNS OF WHEAT, BARLEY AND OAT SEEDLINGS UNDER VARYING CONDITIONS OF SOIL MOISTURE,
W68-01190 03F

TOLLEY, G. S.
ECONOMICS IN WATER RESEARCH,
W68-01115 06B

TRELEASE, FRANK J.
POLICIES FOR WATER LAW PROPERTY RIGHTS, ECONOMIC FORCES, AND PUBLIC REGULATION,
W68-01312 06B

W68-01313 06B

ULOMOV, V.
THE TASHKENT EARTHQUAKE,
W68-01205 08E

VESIC, ALEKSANDAR S.
THEORETICAL STUDIES OF CRATERING MECHANISMS AFFECTING THE STABILITY OF CRATERED SLOPES,
W68-01195 08D

WAITE, GRAHAM G.
PUBLIC RIGHTS IN INDIANA WATERS,
W68-01337 06E

WAIT, RICHARD
THE MONUMENTS OF TITLE OF MASSACHUSETTS TO HER SUBMERGED SEA LANDS,
W68-01395 06E

WAKEFIELD, JOHN W.
THE ADMINISTRATION OF WATER LAWS IN FLORIDA,
W68-01356 06C

WALDRON, L. J.
BULK VOLUME AND HYDRAULIC CONDUCTIVITY CHANGES DURING SODIUM SATURATION TESTS,
W68-01070 02G

WALTE, G. GRAHAM
A FOUR STATE COMPARATIVE ANALYSIS OF PUBLIC RIGHTS IN WATER,
W68-01310 06B

WARNICK, ERLEND B.
ELECTRONIC ANALOG MODELING AS AN AID IN WATER RESOURCE INVESTIGATIONS,
W68-01232 03B

WATTS, J. L.
ELECTRICAL WATER LEVEL AND FLOW INDICATION AND CONTROL,
W68-01238 07B

WEBSTER, DANIEL L.
EFFECTS OF REPEATED DROUGHT PERIODS ON PHOTOSYNTHESIS AND SURVIVAL OF CEREAL SEEDLINGS,
W68-01188 03F

WEINBERGER, HERSHEL
NONSTEADY-STATE FLOW IN PHREATIC AQUIFERS,
W68-01227 02F

WEINBERGER, MORRIS
ECONOMIC EVALUATION OF THE SMALL WATERSHED PROGRAM,
W68-01378 04D

WEISBROD, BURTON A.
INCOME REDISTRIBUTION EFFECTS AND BENEFIT-COST ANALYSIS,
W68-01050 06C

WERSHAW, ROBERT L.
PHYSICAL-CHEMICAL PROPERTIES OF NATURALLY OCCURRING POLIELECTROLYTES--(PART) 1, SODIUM HUMATE,
W68-01253 02K

WHITESIDE, MELBOURNE C.
UNUSUAL MONOMIXIS IN TWO SALINE ARIZONA PONDS,
W68-01095 03C

WHITE, D. E.
GROUND-WATER RESOURCES OF UPTON COUNTY, TEXAS,
W68-01036 04B

WIEGAND, C. L.
INFLUENCES OF PLANT MOISTURE STRESS, SOLAR RADIATION, AND AIR TEMPERATURE ON COTTON LEAF TEMPERATURE,
W68-01071 03F

WILCOX, D. E.
RECLAMATION OF ANCIENT AGRICULTURAL SOILS IN WAHIDI, SOUTH ARABIA,
W68-01177 03C

WILHELMSEN, H.
WATER LEVEL PROBE,
W68-01021 07B

WILLIAMS, W. D.
CHEMICAL AND BIOLOGICAL STUDIES ON SOME SALINE LAKES OF SOUTH-EAST AUSTRALIA,
W68-01082 02H

WILSON, L. G.
BOUNDARY FLOW IN LABORATORY PERMEAMETERS USED TO STIMULATE RECHARGE BY CYCLIC WATER SPREADING,
W68-01120 02G

WISNER, D. A.
IDENTIFICATION OF AQUIFER PARAMETERS BY DECOMPOSITION AND MULTILEVEL OPTIMIZATION,
W68-01047 02F

WOODRUFF, J. W., JR.
WATER RESOURCES PLANNING IN THE SOUTHEASTERN UNITED STATES,
W68-01358 06E

WOODRUFF, N. P.
A MONTHLY CLIMATIC FACTOR FOR THE WIND EROSION EQUATION,
W68-01086 02G

WORCESTER, B. K.
BOUNDARY FLOW IN LABORATORY PERMEAMETERS USED TO STIMULATE RECHARGE BY CYCLIC WATER SPREADING,
W68-01120 02G

WORKER, GEORGE F., JR.
FACTORS AFFECTING THE EMERGENCE OF SUGAR BEETS IN AN IRRIGATED DESERT ENVIRONMENT,
W68-01187 03F

WU, T. H.
LONG-TERM DEFORMATION IN CLAY,
W68-01198 08D

WYRICK, GRANVILLE G.
GROUND-WATER RESOURCES OF THE APPALACHIAN REGION,
W68-01140 03B

YAMAMOTO, M.
ULTRASONIC METHOD OF FLOW MEASUREMENT,
W68-01240 07B

YANG, JIU-SHENNG
INTERACTION OF DIPYRIDYLIUM HERBICIDES AND SOIL MICROORGANISMS,
W68-01282 05B

YANG, TSUNG
SAND DISPERSION IN A LABORATORY FLUME,
W68-01247 02J

YEN, YIN-CHAO
NONSTEADY COMPRESSIBLE FLOW THROUGH ANISOTROPIC POROUS MEDIUMS WITH PARTICULAR REFERENCE TO SNOW,
W68-01128 02C

YIANNOPOULOS, A. N.
COMMON, PUBLIC, AND PRIVATE THINGS IN LOUISIANA CIVILIAN TRADITION AND MODERN PRACTICE (WATERBODIES),
W68-01340 06E

YOUNG, L. E.
SCOUR AND FILL IN ALLUVIAL CHANNELS WITH PARTICULAR REFERENCE TO BRIDGE SITES,
W68-01139 08A

ORGANIZATIONAL INDEX

A BEYROLLE AND CO LTD AND CEGB, GREAT BRITAIN.
EXPERIENCE WITH TRANSISTORISED PROTECTION IN BRITAIN,
W68-01215 08C

AGRICULTURAL RESEARCH SERVICE, BUSHLAND, TEXAS.
LANDFORMING FOR LEACHING OF SALINE SOILS IN A NONIRRIGATED AREA,
W68-01087 03F

AGRICULTURAL RESEARCH SERVICE, RIESEL, TEX.
FIELD AND LABORATORY EXPERIMENTAL APPROACHES,
W68-01233 02E

ALABAMA UNIV. SCHOOL OF LAW.
REAL PROPERTY - SURFACE WATERS - COMMON ENEMY RULE AMPLIFIED,
W68-01391 06E

THE DEVELOPMENT OF RIPARIAN LAW IN ALABAMA,
W68-01401 06E

ALL UNION SCIENTIFIC RESEARCH INSTITUTE OF OIL AND GEOLOGY AND EXPLORATION, MOSCOW.
FILTRATION RATES OF GROUND WATERS,
W68-01136 02G

ALL UNION SCIENTIFIC TECH. INST. OF HYDROTECHNOLOGY.
ROD REINFORCEMENT OF TUNNEL TYPE EXCAVATIONS,
W68-01201 08A

ALL-UNION SCIENTIFIC RES INST OF HYDROGEOLOGY AND GEOL ENG, MOSCOW, USSR.
GROUNDWATER SEEPAGE RATES,
W68-01237 02F

AMERICAN FARM ECONOMIC ASSOC, MENASKA, WIS.
ECONOMIC EVALUATION OF THE SMALL WATERSHED PROGRAM,
W68-01378 04D

AMERICAN FARM ECONOMIC ASSOC., MENASHA, WIS.
SOME ECONOMIC ISSUES IN WATER RIGHTS,
W68-01382 06D

CAN WATER BE ALLOCATED BY COMPETITIVE PRICES,
W68-01383 06C

AMERICAN UNIVERSITY OF BEIRUT, BEIRUT, LEBANON.
EFFECT OF SOIL MOISTURE DEPLETION ON CROP YIELD AND STOMATAL INFILTRATION,
W68-01189 03F

ARC WEED RESEARCH ORGANIZATION, OXFORD, GREAT BRITAIN.
THE CONTROL OF WATER WEEDS,
W68-01235 04A

ARIZ UNIV AND UNIV WATER RESOURCES CENTER, TUCSON.
BOUNDARY FLOW IN LABORATORY PERMEAMETERS USED TO STIMULATE RECHARGE BY CYCLIC WATER SPREADING,
W68-01120 02G

ARIZONA AGRICULTURAL EXPERIMENT STATION, TUCSON.
MICROMORPHOLOGICAL STUDY OF SOIL CRUSTS,
W68-01097 03F

ARIZONA INTERSTATE STREAM COMMISSION, PHOENIX.
SUPPLY.
W68-01181 03B

PRESENT USES AND WATER ECONOMY.
W68-01182 06B

WATER COSTS.
W68-01183 06C

FUTURE WATER REQUIREMENTS.
W68-01184 06D

PLANNING FOR WATER RESOURCE DEVELOPMENT.
W68-01185 06B

ARIZONA STATE UNIV., TEMPE, ZOOLOGY DEPT.
UNUSUAL MONOMIXIS IN TWO SALINE ARIZONA PONDS,
W68-01095 03C

ARIZONA STATE UNIV., TEMPE DESERT RESEARCH INSTITUTE, NEVADA SOUTHERN UNIV., LAS VEGAS.
SOUTHWESTERN FISHES AND THE ENIGMA OF 'ENDANGERED SPECIES',
W68-01102 06G

ARIZONA UNIV, LABORATORY OF TREE-RING RESEARCH, TUCSON.
CONDITIONAL PROBABILITY OF OCCURRENCE FOR VARIATIONS IN CLIMATE BASED ON WIDTHS OF ANNUAL TREE RINGS IN ARIZONA,
W68-01251 02B

ARIZONA UNIV., TUCSON, ARIZONA COOPERATIVE FISHERY UNIT.
LIMNOLOGICAL EFFECTS OF ORGANIC EXTRACTS OF LITTER IN A SOUTHWESTERN IMPOUNDMENT,
W68-01093 02H

ARIZONA UNIV., TUCSON.
TIME OF FERTILIZER APPLICATION ON DESERT GRASSLANDS,
W68-01068 03F

RAINFALL COLLECTION FOR DOMESTIC WATER SUPPLIES,
W68-01079 03F

ARIZONA UNIV., TUCSON. AGRICULTURAL EXPERIMENT STATION.
NATURAL RECHARGE IN TUCSON BASIN,
W68-01080 04B

ARIZONA UNIV., TUCSON. WATER RESOURCES RESEARCH CENTER.
RAFTS NEW WAY TO CONTROL EVAPORATION,
W68-01067 03F

ARKANSAS UNIV., FAYETTEVILLE.
RESISTANCE OF TEXAS SALT - AND FRESHWATER - MARSH FISHES TO HEAT DEATH AT VARIOUS SALINITIES,
W68-01073 05C

AUBURN UNIV, DEPT. OF BOTANY AND PLANT PATHOLOGY.
FACTORS AFFECTING PERSISTENCE AND INACTIVATION OF DIQUAT AND PARAQUAT,
W68-01274 05B

AUBURN UNIV.
REVIEW OF THE METABOLISM AND DECOMPOSITION OF DIQUAT AND PARAQUAT,
W68-01275 05A

PHOTOCHEMICAL DECOMPOSITION OF DIQUAT AND PARAQUAT,
W68-01276 05A

CHEMICALS MAY CONTROL STUBBORN ALLIGATORWEED,
W68-01277 04A

THE EFFECT OF DICHLOBENIL AND DICAMBA ON NODAL TISSUES OF ALLIGATORWEED,
W68-01278 04A

PERSISTENCE OF DIQUAT, PARAQUAT, AND 2,4-DBEE WHEN USED FOR EURASIAN WATERMILFOIL CONTROL,
W68-01279 04A

EFFECTIVENESS OF HERBICIDAL COMBINATIONS ON ALLIGATORWEED GROWING IN FLOWING WATER,
W68-01280 04A

METABOLISM OF FLUOMETURON BY SEVERAL BIOLOGICAL SYSTEMS,
W68-01281 05A

INTERACTION OF DIPYRIDYLIUM HERBICIDES AND SOIL MICROORGANISMS,
W68-01282 05B

ABSORPTION, TRANSLOCATION, AND METABOLISM OF C-14-LABELED DICHLOBENIL,
W68-01283 04A

AUBURN UNIV., AUBURN, ALABAMA.
EFFECT OF MORPHACTINS ON BEAN AND ALLIGATORWEED,
W68-01284 04A

AUKLAND UNIVERSITY, NEW ZEALAND.
ONSET OF THERMOHALINE CONVECTION IN A POROUS MEDIUM,
W68-01038 08B

BECHTEL CORP., VERNON, CALIF.
NEW CONCEPTS FOR DESALTING BRACKISH WATER,
W68-01126 03A

BINNIE AND PARTNERS.
MANGLA INSTRUMENTATION,
W68-01239 07B

BOWDOIN COLLEGE, BRUNSWICK, MAINE.
SIX FEDERAL RECLAMATION PROJECTS AND THE DISTRIBUTION OF INCOME,
W68-01056 06B

BROOKLYN COLLEGE, NEW YORK.
MODIFICATION OF THE PERMEABILITY OF LOESS BY ELECTROLYTES,
W68-01098 02G

BROWN, BOVERI AND CO, LTD, BADEN, SWITZERLAND.
TRANSIENT RECOVERY VOLTAGE CAUSED BY DIFFERENT SWITCHING OPERATIONS IN HV NETWORKS CONTAINING UNDERGROUND CABLES,
W68-01211 08C

BUREAU OF RECLAMATION, DENVER, COLO.
STRUCTURAL BEHAVIOR MEASUREMENTS FOR PENSTOCKS THROUGH CONCRETE DAMS HUNGRY HORSE AND CANYON FERRY DAMS,
W68-01222 08A

BUREAU OF RECLAMATION, DENVER, EARTH LABORATORY BRANCH.
RESEARCH ON ELECTRORECLAMATION OF SALINE-ALKALI SOILS,
W68-01108 02K

CAIRO UNIV. NATIONAL RESEARCH CENTER EL-AZHAR UNIV.
A PRELIMINARY STUDY ON THE EFFECT OF ARTIFICIALLY CREATED LAYERS IN SANDY SOILS ON YIELD OF ALFALFA,
W68-01099 03F

CALIFORNIA AGRICULTURAL EXPERIMENT STATION, BERKELEY.
INTEGRATING MANAGEMENT OF GROUND AND IMPORTED WATER IN LOS ANGELES COUNTY,
W68-01193 03D

CALIFORNIA DEPARTMENT OF WATER RESOURCES.
HYDROLOGIC DATA 1966 VOLUME 3--CENTRAL COASTAL AREA, APPENDICES A-E.
W68-01259 02A

CALIFORNIA DEPARTMENT WATER RESOURCES.
HYDROLOGIC DATA 1966 VOLUME V--SOUTHERN CALIFORNIA,

APPENDICES A-C.
W68-01260 02A

CALIFORNIA STATE DEPARTMENT OF WATER RESOURCES, SACRAMENTO.
GEODIMETER FAULT MOVEMENT INVESTIGATIONS IN CALIFORNIA,
W68-01224 08E

CALIFORNIA UNIV, BERKELEY AND DAVIS OFFICE OF THE AGRICULTURAL COMMISSIONER, MONTEREY CO, CALIF.
OVERHEAD IRRIGATION ENCOURAGES WET-WEATHER PLANT DISEASES,
W68-01192 03F

CALIFORNIA UNIV, LOS ANGELES STATE DEPT. OF WATER RESOURCES, FRESNO.
INSECTICIDES IN TILE DRAINAGE EFFLUENT,
W68-01191 05G

CALIFORNIA UNIV., BERKELEY.
RECREATION BENEFITS FROM WATER POLLUTION CONTROL A FURTHER NOTE ON BENEFIT EVALUATION,
W68-01055 06B

BULK VOLUME AND HYDRAULIC CONDUCTIVITY CHANGES DURING SODIUM SATURATION TESTS,
W68-01070 02G

PERUVIAN DESERT MICE WATER INDEPENDENCE, COMPETITION, AND BREEDING CYCLE NEAR THE EQUATOR,
W68-01081 02I

LINEAR DYNAMIC DECOMPOSITION PROGRAMMING APPROACH TO LONG-RANGE OPTIMIZATION OF NORTHERN CALIFORNIA WATER RESOURCES SYSTEM, PART I DETERMINISTIC HYDROLOGY,
W68-01152 06A

CALIFORNIA UNIV., DAVIS IMPERIAL VALLEY FIELD STATION, EL CENTRO.
FACTORS AFFECTING THE EMERGENCE OF SUGAR BEETS IN AN IRRIGATED DESERT ENVIRONMENT,
W68-01187 03F

CALIFORNIA UNIV., DAVIS.
PREHARVEST WATER STRESS FOR VALLEY SUGAR BEETS,
W68-01101 03F

CALIFORNIA UNIV., DEPT. OF ENG., LOS ANGELES.
IDENTIFICATION OF AQUIFER PARAMETERS BY DECOMPOSITION AND MULTILEVEL OPTIMIZATION,
W68-01047 02F

CALIFORNIA UNIV., LOS ANGELES.
THE USE OF SHADOW PRICES,
W68-01065 06B

THE OPTIMUM MANAGEMENT OF GROUND WATER RESOURCES,
W68-01156 04B

CALIFORNIA UNIV., RIVERSIDE ORANGE COUNTY WATER DISTRICT.
EFFECTS OF SURFACE SEDIMENTS ON GROUNDWATER RECHARGE,
W68-01085 04B

CALIFORNIA UNIV., RIVERSIDE.
WATER BALANCE IN DESERT ARTHROPODS,
W68-01069 02I

CANADA DEPARTMENT OF ENERGY, MINES AND RESOURCES, OTTAWA, CANADA.
FLUVIAL PROCESSES IN THE HIGH ARCTIC,
W68-01029 02C

DEVELOPMENT, LANDFORMS AND CHRONOLOGY OF GENERATOR LAKE, BAFFIN ISLAND, N W T,
W68-01035 02C

HYDROLOGY OF THE LEWIS GLACIER, NORTH-CENTRAL BAFFIN ISLAND, N W T, AND DISCUSSION OF RELIABILITY OF THE MEASUREMENTS.
W68-01041 02C

CENTRAL ARID ZONE RESEARCH INSTITUTE, JODHPUR, INDIA.
QUALITY OF GROUNDWATER FOR IRRIGATION IN AHOR DEVELOPMENT BLOCK, JALORE DISTRICT, WESTERN RAJASTHAN,
W68-01091 03C

CHICAGO UNIV.
WATER LAW AND PRIVATE DECISION-MAKING A CRITIQUE,
W68-01397 06D

CHICAGO UNIV. LAW SCHOOL.
WATER LAW AND DECISION-MAKING A CRITIQUE,
W68-01400 06C

CHICAGO UNIV., CHICAGO DEPARTMENT OF ECONOMICS.
ECONOMICS IN WATER RESEARCH,
W68-01115 06B

COLORADO STATE UNIV., DEPARTMENT OF CIVIL ENGINEERING, FORT COLLINS.
SAND DISPERSION IN A LABORATORY FLUME,
W68-01247 02J

COLORADO STATE UNIV., FORT COLLINS.
THE DYNAMICS OF PUBLIC ROLES IN THE SELECTION OF REVENUE SOURCES IN LOCAL WATER ADMINISTRATION,
W68-01061 06C

DISPERSION OF MASS IN OPEN-CHANNEL FLOW,
W68-01129 08B

COLUMBIA UNIV., NEW YORK.
BOUNDARY PROBLEMS RAISED BY THE SUBMERGED LANDS ACT,
W68-01394 06E

COMMITTEE ON BAR ASS'N Q, HARRISBURG, PA.
PROTECTING OUR WATER RESOURCES,
W68-01345 03F

CORNELL UNIV., ITHACA, N. Y.
PROBABILISTIC MODELS FOR PREDICTING STREAM QUALITY,
W68-01149 05F

COMPUTER MODELS FOR RESERVOIR REGULATION,
W68-01154 06A

A COMMENT ON OPTIMIZATION METHODS FOR BRANCHING MULTISTAGE WATER RESOURCE SYSTEMS,
W68-01158 06A

LINEAR PROGRAMMING MODELS FOR WATER POLLUTION CONTROL,
W68-01159 05G

ADAPTATION BY MICROBIAL POPULATIONS,
W68-01168 05D

CORPS OF ENGINEERS, VICKSBURG, MISS.
THE EFFECT OF PLACEMENT METHOD ON THE RESPONSE OF SOIL STRESS GAGES,
W68-01202 08D

CSIRO, CANBERRA, ACT, DIVISION OF PLANT INDUSTRY.
MOISTURE AND TEMPERATURE REQUIREMENTS FOR GERMINATION OF THREE ANNUAL SPECIES OF MEDICAGO,
W68-01107 02I

CSIRO, CANBERRA, AUSTRALIA.
SOME PHYSICAL ASPECTS OF INTERNAL CONTROL OF LEAF TRANSPIRATION,
W68-01109 02D

DANISH GEOTECHNICAL INSTITUTE, COPENHAGEN, DENMARK.
RIGID PIPES IN SYMMETRICAL AND UNSYMMETRICAL TRENCHES,
W68-01207 08D

DEPARTMENT OF AGRICULTURE, WERRIBEE, VICTORIA, STATE RESEARCH FARM.
A COMPARISON OF GYPSUM BLOCKS AND EVAPORIMETERS FOR IRRIGATION CONTROL,
W68-01104 03F

DEPT OF LAW, UNIVERSITY EXTENSION, U OF WISCONSIN, MADISON.
A FOUR STATE COMPARATIVE ANALYSIS OF PUBLIC RIGHTS IN WATER,
W68-01310 06B

DEPT OF THE INTERIOR, FED WATER POLLUT CONTR ADMIN, PHILADELPHIA, PA.
DELAWARE ESTUARY COMPREHENSIVE STUDY, PRELIMINARY REPORT AND FINDINGS.
W68-01167 05G

DEPT. OF CIVIL ENGINEERING, MASSACHUSETTS INSTITUTE OF TECHNOLOGY, CAMBRIDGE, MASSACHUSETTS.
DISPERSION IN LAYERED POROUS MEDIA,
W68-01178 08D

DEPT. OF PUBLIC WORKS, NASSAU COUNTY, N. Y. BURNS AND ROE, INC., ORADELL, N. J.
WATER CONSERVATION BY RECLAMATION AND RECHARGE,
W68-01048 05D

DESERT RESEARCH INSTITUTE, NEVADA UNIV., RENO.
OPTIMAL GROUND-WATER MINING,
W68-01110 06A

DETROIT UNIV.
DIVERSION OF LAKE MICHIGAN WATERS,
W68-01380 05E

WATER POLLUTION CONTROL IN THE GREAT LAKES REGION,
W68-01392 05G

DUKE UNIVERSITY, DURHAM, N C.
THEORETICAL STUDIES OF CHATERING MECHANISMS AFFECTING THE STABILITY OF CHATERED SLOPES,
W68-01195 08D

EMPIRE COTTON GROWING CORP., LONDON DEPT., OF AGRICULTURE, FEDERATION OF SOUTH ARABIA.
RECLAMATION OF ANCIENT AGRICULTURAL SOILS IN WAHIDI, SOUTH ARABIA,
W68-01177 03C

ENEL, MILAN, ITALY.
MEASURING INTERNAL TEMPERATURES IN MASS CONCRETE,
W68-01203 08G

ENVIRONMENTAL SCIENCE SERVICE ADMINISTRATION, SILVER SPRING, MD.
NEW DISTRIBUTIONS OF EXTREME WINDS IN THE UNITED STATES,
W68-01200 07A

FEDERAL WATER POLLUTION CONTROL ADMINISTRATION, U.S. DEPARTMENT OF THE INTERIOR, WASHINGTON, D. C.
A STUDY IN THE ECONOMICS OF WATER QUALITY MANAGEMENT,
W68-01051 05G

FEDERAL WATER POLLUTION CONTROL ADMIN.
EUTROPHICATION IS BEGINNING IN LAKE MICHIGAN,
W68-01244 05C

FED. WATER POLLUT. CONTR. ADMIN., CINCINNATI, OHIO.
AUTOMATED WATER QUALITY MONITORING,
W68-01049 05A

FLORIDA UNIV., GAINESVILLE HARVARD UNIV., CAMBRIDGE, MASSACHUSETTS.
SIMULATION OF A NATIONAL FLOOD INSURANCE FUND,
W68-01062 06F

FOXBORO CO., FOXBORO, MASS.
SELECTIVE ION ELECTRODE SYSTEM FOR FLUORIDE ANALYSIS,
W68-01116 07B

J W MURPHY INDUSTRIES, HOUSTON, TEX.
BIG-HOLE DRILLING IS COMING OF AGE UNDERGROUND,
W68-01196 08H

GDANSK TECHNICAL UNIVERSITY, POLAND.
ANALISIS OF THE STABILITY OF COFFERDAMS WITH DOUBLE SHEET WALLS ACCORDING TO FIELD AND MODEL TESTS,
W68-01228 08A

GEOLOGICAL SOCIETY OF AMERICA, SOUTHEASTERN SECTION, DURHAM, N. C.
SEDIMENTATION IN ONSLOW BAY (IN GUIDEBOOK FOR FIELD EXCURSIONS, GEOLOGICAL SOCIETY OF AMERICA, SOUTHEASTERN SECTION),
W68-01262 02L

GEOLOGICAL SURVEY OF ALABAMA, UNIVERSITY, ALA.
MINERALS AND WATER, BUTLER COUNTY, ALABAMA.
W68-01137 03B

GEORGIA BAR ASSOC., MACON.
GEORGIA WATER LAW, USE AND CONTROL FACTORS,
W68-01402 06B

GEORGIA INSTITUTE OF TECHNOLOGY, ATLANTA.
PILOT PLANT STUDIES ON THE ANAEROBIC TREATMENT OF TANNERY EFFLUENTS,
W68-01125 05D

GHANA UNIV., LEGON. DEPARTMENT OF BOTANY.
OBSERVATIONS ONMICROCLIMATE AND VEGETATION INTERRELATIONSHIPS ON THE ACCRA PLAINS (GHANA),
W68-01077 02D

HARVARD UNIVERSITY, CAMBRIDGE, MASS.
THE ANIMAL FARM A MATHEMATICAL MODEL FOR THE DISCUSSION OF SOCIAL STANDARDS FOR CONTROL OF THE ENVIRONMENT,
W68-01157 06B

HARVARD UNIV., CAMBRIDGE, MASS.
INDUS RIVER BASIN STUDIES.
W68-01148 03C

MATHEMATICAL MODELS THE MULTISTRUCTURE APPROACH TWO SEASONS, PREDICTABLE HYDROLOGY,
W68-01153 06A

MATHEMATICAL MODELS THE MULTISTRUCTURE APPROACH MORE PERIODS, PREDICTABLE HYDROLOGY,
W68-01163 06A

MATHEMATICAL MODELS THE MULTISTRUCTURE APPROACH ALLOWANCE FOR UNCERTAINTY,
W68-01166 06A

HARZA ENGINEERING COMPANY.
USE OF MODERN EQUIPMENT AND TECHNIQUES IN THE PLANNING AND DEVELOPMENT OF WATER RESOURCES,
W68-01160 06A

HEBREW UNIV., JERUSALEM, ISRAEL.
A STATISTICAL INVESTIGATION OF PERSISTENCE IN THE ISRAELI ARTIFICIAL RAINFALL STIMULATION EXPERIMENT,
W68-01094 03B

XEROPHYTIC STRUCTURES IN THE ROOTS OF DESERT SHRUBS,
W68-01170 02I

ILLINOIS STATE WATER SURVEY, URBANA, ILLINOIS.
THE ADJUSTMENT OF RADAR ESTIMATES OF STORM MEAN RAINFALL WITH RAIN GAGE DATA,
W68-01180 02B

PRECIPITATION CLIMATOLOGY OF LAKE MICHIGAN BASIN,
W68-01254 02B

INDIAN INSTITUTE OF SCIENCE, BANGALORE, INDIA.
SOME STUDIES ON NEW TYPES OF FRICTION BLOCKS,
W68-01258 08B

INDIANA UNIVERSITY, BLOOMINGTON.
AN ECOSYSTEMS APPROACH TO PUBLIC LAND POLICY,
W68-01206 06G

INSTITUTE OF LAW AND GOVERNMENT, COLLEGE OF LAW, GEORGIA UNIV., ATHENS.
WATER LAW AND POLICY IN THE SOUTHEAST.
W68-01348 06E

WATER POLLUTION CONTROL IN NORTH CAROLINA,
W68-01353 06E

INSTITUTE OF LAW AND GOVERNMENT, COLLEGE OF LAW, GEORGIA UNIV, ATHENS.
REGULATION OF WATER USE IN LOCAL AREAS BY STATE OR LOCAL GOVERNMENTS AND DISTRICTS,
W68-01355 06E

THE ADMINISTRATION OF WATER LAWS IN FLORIDA,
W68-01356 06C

INSTITUTE OF LAW AND GOVERNMENT, COLLEGE OF LAW, U OF GEORGIA, ATHENS.
WATER USE LAW IN ACTION,
W68-01354 06E

EASTERN LAWS CONCERNING MINIMUM STREAM FLOWS AND IMPOUNDMENTS,
W68-01357 06E

INSTITUTE OF LAW AND GOVERNMENT, SCHOOL OF LAW, GEORGIA UNIV., ATHENS.
COMMON LAW RULES REGARDING THE USE OF SURFACE AND GROUND WATER IN THE SOUTHEASTERN STATES,
W68-01349 06E

STATUTES FOR ADMINISTERING WATER USE IN THE SOUTHEAST,
W68-01350 06E

MISSISSIPPI WATER-USE LAWS AND ADMINISTRATION,
W68-01351 06E

LEGAL BASIS FOR WATER POLLUTION CONTROL,
W68-01352 06E

INSTITUTE OF LAW AND GOVERNMENT, SCHOOL OF LAW, U OF GEORGIA, ATHENS.
WATER RESOURCES PLANNING IN THE SOUTHEASTERN UNITED STATES,
W68-01358 06E

INSTITUTE OF PAPER CHEMISTRY, APPLETON, WIS.
WASTE PRODUCT USE HELPS PAPER INDUSTRY CONTROL POLLUTION,
W68-01255 05B

INTERNATIONAL ASSOCIATION OF SEISMOLOGY AND PHYSICS OF THE EARTH'S INTERIOR, STRASBOURG, FRANCE.
FILL A LAKE, START AN EARTHQUAKE,
W68-01220 08E

INTERSTATE COMM'N ON THE POTOMAC RIVER BASIN, WASHINGTON.
A SYMPOSIUM ON SUPPLEMENTAL IRRIGATION.
W68-01396 03F

IOWA STATE UNIV.
WATER RIGHTS IN IOWA,
W68-01384 06E

IRRIGATION RESEARCH STATION POONDI, MADRAS, INDIA.
RETARDATION OF EVAPORATION FROM OPEN WATER STORAGES,
W68-02256 03B

ISRAEL MINISTRY OF AGRICULTURE, JERUSALEM.
HYDROLOGICAL YEAR-BOOK OF ISRAEL 1965/66.
W68-01119 02A

JOHN MARSHALL LAW SCHOOL, CHICAGO.
DECISIONS RELATING TO DISTRIBUTION OF PUBLIC WATER SUPPLIES,
W68-01374 03D

JOHNS HOPKINS UNIVERSITY, BALTIMORE, DEPARTMENT OF MECHANICS.
ON WAKES IN STRATIFIED FLUIDS,
W68-01040 08B

JOHNS HOPKINS UNIV., BALTIMORE, MD.
BALAS ALGORITHM FOR ZONED UNIFORM TREATMENT,
W68-01161 05D

JOHNS HOPKINS UNIV., CHESAPEAKE BAY INSTITUTE, BALTIMORE, MARYLAND.
SUSPENDED SEDIMENT OF THE NORTHERN CHESAPEAKE BAY,
W68-01268 02L

KENTUCKY LEGISLATIVE RESEARCH COMMISSION.
WATER RIGHTS LAW IN KENTUCKY.
W68-01385 06E

WATER RIGHTS LAW IN KENTUCKY -- HISTORICAL DEVELOPMENT OF KENTUCKY WATER LAW.
W68-01386 06E

WATER RIGHTS LAW IN KENTUCKY - WATER SUPPLY OF KENTUCKY.
W68-01387 03B

WATER RIGHTS LAW IN KENTUCKY - WATER USE IN KENTUCKY.
W68-01388 03D

WATER RIGHTS LAW IN KENTUCKY - ALTERNATIVE LEGAL APPROACHES.
W68-01389 06E

KENTUCKY UNIV., LEXINGTON. DEPT. OF CIVIL ENGINEERING.
ECONOMIC ANALYSIS OF ALTERNATIVE FLOOD CONTROL MEASURES,
W68-01052 06F

LAND AND MARINE CONTRACTORS LTD, GREAT BRITAIN.
SUBMARINE PIPELINES,
W68-01199 08A

LAWYERS CO-OP, ROCHESTER, N. Y. BANCROFT-WHITNEY CO., SAN FRANCISCO, CALIF.
TRANSFER OF RIPARIAN RIGHT TO USE WATER TO NONRIPARIAN LAND.
W68-01372 06E

MAINE UNIV., WATER RESOURCES CENTER, ORONO, MAINE.
WATER QUALITY DEGRADATION BY WOOD BARK POLLUTANTS,
W68-01269 05C

MARYLAND GEOLOGICAL SURVEY, BALTIMORE.
WATER RESOURCES OF THE SALISBURY AREA, MARYLAND,
W68-01141 03B

MASSACHUSETTS BAR ASSOC., BOSTON.
THE MUNIMENTS OF TITLE OF MASSACHUSETTS TO HER SUBMERGED SEA

LANDS,
W68-01395 06E

MASSACHUSETTS INSTITUTE OF TECHNOLOGY, CAMBRIDGE.
WAVE PROPAGATION AND BOUNDARY INSTABILITY IN ERODIBLE-BED CHANNELS,
W68-01236 08B

MCKINSEY AND COMPANY, INC., SAN FRANCISCO, CALIF.
SUGAR CANE IRRIGATION A CASE STUDY IN CAPITAL BUDGETING,
W68-01164 03F

MELBOURNE UNIV., PARKVILLE, VICTORIA SOIL CONSERVATION AUTHORITY OF VICTORIA, KEW, VICTORIA.
EDAPHIC RANGE AND COHABITATION OF SOME MALLEE EUCALYPTS IN SOUTH-EASTERN AUSTRALIA,
W68-01078 02I

METEOROLOGICAL OFFICE, POONA, INDIA.
ARID-ZONE AGROMETEOROLOGY IN INDIA,
W68-01171 02B

MICHIGAN TECHNOLOGICAL UNIV, HOUGHTON.
CHARACTERISTICS OF INTERFACE FLOW IN SUBSURFACE DISPOSAL SYSTEMS,
W68-01245 05G

MINISTRY OF AGRICULTURE, WINNIPEG, CANADA IOWA STATE UNIVERSITY, AMES.
INTEGRATING FARM AND WATERSHED PLANNING IN SOIL AND WATER RESOURCE MANAGEMENT,
W68-01234 03F

MISSOURI UNIV. SCHOOL OF LAW, COLUMBIA.
THE RIGHTS OF A RIPARIAN LANDOWNER IN MISSOURI,
W68-01390 06E

MISSOURI UNIV., COLUMBIA.
TEMPORAL ALLOCATION OF GROUNDWATER,
W68-01060 06C

MONASH UNIV., CLAYTON, VICTORIA.
CHEMICAL AND BIOLOGICAL STUDIES ON SOME SALINE LAKES OF SOUTH-EAST AUSTRALIA,
W68-01082 02H

NATIONAL BUREAU OF STANDARDS, WASHINGTON, D. C.
PERFORMANCE OF DUCTILE-IRON PIPE IN SOILS,
W68-01194 08G

EXPRESSION OF THE UNCERTAINTIES OF FINAL RESULTS,
W68-01204 07C

NATIONAL REACTOR TESTING STATION, IDAHO FALLS, IDAHO, HEALTH SERVICE LAB.
WATER LEVEL PROBE,
W68-01021 07B

NEW MEXICO INSTITUTE OF MINING AND TECHNOLOGY, SOCORRO.
FLOW OF GROUNDWATER IN RELATIVELY THICK LEAKY AQUIFERS,
W68-01186 02F

NEW MEXICO INSTITUTE OF MINING AND TECHNOLOGY.
GROWTH AND DECAY OF GROUNDWATER-MOUNDS IN RESPONSE TO UNIFORM PERCOLATION,
W68-01083 04B

NORTH CAROLINA UNIV, CHAPEL HILL.
REAL PROPERTY - RIPARIAN RIGHTS,
W68-01381 06E

NORTH CAROLINA UNIV., DEPARTMENT OF ENVIRONMENTAL SCIENCES AND ENGINEERING, CHAPEL HILL.
THE HIERARCHY OF WATER QUALITY,
W68-01257 03D

OAKLAHOMA STATE UNIV., STILLWATER.
TRANSPIRATION PATTERNS OF WHEAT, BARLEY AND OAT SEEDLINGS UNDER VARYING CONDITIONS OF SOIL MOISTURE,
W68-01190 03F

OHIO STATE UNIVERSITY, COLUMBUS.
LONG-TERM DEFORMATION IN CLAY,
W68-01198 08D

OHIO STATE UNIV., COLUMBUS.
MOISTURE STRESS IN A VEGETATIONAL CONTINUUM IN THE SONORAN DESERT,
W68-01103 03F

OKLAHOMA STATE UNIV., STILLWATER.
EFFECTS OF REPEATED DROUGHT PERIODS ON PHOTOSYNTHESIS AND SURVIVAL OF CEREAL SEEDLINGS,
W68-01188 03F

OREGON COLLEGE OF EDUCATION, MONMOUTH.
STREAMFLOW FLUCTUATION, BAR ROUGHNESS, AND BED LOAD MOVEMENT A HYPOTHESIS,
W68-01044 02E

OREGON STATE UNIV., CORVALLIS, OREGON AGRICULTURAL EXPERIMENT STATION.
WATER RESOURCES ALLOCATION, EXTRAMARKET VALUES, AND MARKET CRITERIA A SUGGESTED APPROACH,
W68-01111 06B

PAKISTAN FOREST INSTITUTE, PESHAWAR.
CRIB DAMS FOR CONTROL OF SEDIMENT AND STREAMBED EROSION AND THEIR SUITABILITY FOR CONDITIONS IN PAKISTAN,
W68-01179 08D

PHILADELPHIA ELECTRIC CO, PA AND AMERICAN ELECTRIC POWER SERVICE CORP, NEW YORK, N Y.
STUDIES ON THE INTEGRATION OF A D-C TRANSMISSION LINE INTO AN A-C NETWORK,
W68-01218 08C

PROCTER AND GAMBLE CO., CINCINNATI, OHIO.
EFFECT OF TALLOW ALCOHOL ADDED TO SOIL ON THE TENSION, FLOW, AND EVAPORATION OF SOIL WATER,
W68-01173 02G

PUBLIC HEALTH SERVICE, PHILADELPHIA, PA.
USE OF SYSTEMS ANALYSIS IN ESTUARINE WATER POLLUTION CONTROL,
W68-01162 05G

PURDUE UNIV., WEST LAFAYETTE, IND.
EFFECTS OF TEMPERATURE AND PRESSURE ON UNFROZEN SOIL WATER,
W68-01264 02C

RESOURCES FOR THE FUTURE, INC., WASHINGTON, D. C., DEPT. OF THE INTERIOR, WASHINGTON, D. C.
THE IMPACT OF PRICE ON RESIDENTIAL WATER DEMAND AND ITS RELATION TO SYSTEM DESIGN AND PRICE STRUCTURE,
W68-01053 06D

RESOURCES FOR THE FUTURE, INC., WASH., D. C.
COMPARISONS OF METHODS FOR RECREATION EVALUATION,
W68-01063 06B

THE COLUMBIA RIVER TREATY,
W68-01064 06E

RESOURCES FOR THE FUTURE, WASHINGTON, D. C.
WATER RESOURCE DEVELOPMENT IN CALIFORNIA,
W68-01058 06B

ROCKY MOUNTAIN FOREST AND RANGE EXPERIMENT STATION, FORT COLLINS, COLORADO.
EFFECT OF GRAZING ON INFILTRATION IN A WESTERN WATERSHED,
W68-01105 04D

RYAZAN AGRICULTURAL INSTITUTE, RYAZAN, USSR.
RATES OF EROSION AND SOIL FORMATION (IN THE HUMID AND ARID SUBTROPICS OF THE USSR),
W68-01169 02J

SIEMENS A G AND A E G-TELEFUNKEN, BERLIN, GERMANY BROWN BOVERI AND CO LTD, BADEN, SWITZERLAND.
RESULTS IN HVDC CONVERTOR TESTING AND UTILIZATION OF THE RHEINAU RESEARCH LABORATORY FACILITIES,
W68-01219 08C

SOIL CONSERVATION SERVICE, SALT LAKE CITY, UTAH.
ELECTRONIC ANALOG MODELING AS AN AID IN WATER RESOURCE INVESTIGATIONS,
W68-01232 03B

SOUTH CAROLINA UNIV., COLUMBIA.
AMERICAN WATER RIGHTS LAW,
W68-01398 06E

STANFORD UNIV., STANFORD, CALIF.
OPTIMAL POLICY FOR HYDROELECTRIC OPERATIONS,
W68-01150 08C

STANFORD UNIV., STANFORD, CALIF. DEPT. OF CIVIL ENGINEERING.
GROWTH OF SPECTRAL COMPONENTS IN A WIND-GENERATED WAVE TRAIN,
W68-01030 08B

STATE BAR OF MICHIGAN, LANSING.
MICHIGAN'S PURLOINED SHORELINES,
W68-01377 06E

STATE U OF IOWA, IOWA CITY.
SOME CURRENT AND PROPOSED WATER-RIGHTS LEGISLATION IN THE EASTERN STATES,
W68-01347 06E

SYRACUSE UNIVERSITY, SYRACUSE, MAXWELL SCHOOL OF CITIZENSHIP AND PUBLIC AFFAIRS.
WATER IN WEST PAKISTAN,
W68-01096 06E

SYRACUSE UNIVERSITY, SYRACUSE, NEW YORK, MAXWELL SCHOOL OF CITIZENSHIP AND PUBLIC AFFAIRS.
WATER IN WEST PAKISTAN,
W68-01054 06B

TECHNICAL UNIVERSITY OF MUNICH, GERMANY.
STRESSES IN TRANSMISSION LINE CONDUCTORS NEAR THE SUSPENSION CLAMP,
W68-01213 08C

TECHNION, ISRAEL INSTITUTE OF TECHNOLOGY, HAIFA.
A PROBLEM OF OPTIMIZING A COLLECTING RESERVOIR SYSTEM,
W68-01151 08A

TEMPLE UNIV SCHOOL OF LAW, PHILADELPHIA.
ENGLISH WATER LAW DOCTRINES BEFORE 1400,
W68-01379 06E

TENNESSEE DEPARTMENT OF PUBLIC HEALTH.
HOW TO OPERATE 'PACKAGE' WASTEWATER TREATMENT PLANTS,
W68-01020 05D

TEXAS A AND M UNIVERSITY.
STUDIES OF THE DRYING OF BARE GROUND,
W68-01076 02D

TEXAS UNIV., AUSTIN BROWN AND ROOT CONSTRUCTION CO., HOUSTON, TEXAS.
GRAIN SIZE DISTRIBUTION AND ITS EFFECT ON THE PERMEABILITY OF UNCONSOLIDATED SANDS,
W68-01175 02G

TULANE UNIV., NEW ORLEANS.
OWNERSHIP OF BEDS OF NAVIGABLE WATERS,
W68-01393 06E

U S ARMY CORPS OF ENGINEERS, WASH, D. C. OFFICE OF CHIEF OF ENGINEERS.
FEATHER RIVER NEAR CHESTER, CALIFORNIA (FLOOD CONTROL).
W68-01037 04A

U S DEPT OF AGRICULTURE, AGRICULTURAL RESEARCH SERVICE, PHOENIX.
EVAPOTRANSPIRATION RATES OF FIELD CROPS DETERMINED BY THE BOWEN RATIO METHOD,
W68-01106 03F

U S DEPT OF AGRICULTURE, AGRICULTURAL RESEARCH SERV.
HYDROLOGIC DATA FOR EXPERIMENTAL AGRICULTURAL WATERSHEDS IN THE UNITED STATES, 1962,
W68-01121 04D

U S DEPT OF AGRICULTURE, ECONOMIC RESEARCH SERVICE, COLUMBIA, MO.
WATER-ORIENTED OUTDOOR RECREATION,
W68-01112 06D

U S GEOLOGICAL SURVEY, DENVER.
USE OF MERCUROUS CHLORIDE TO RECOVER TRACE AMOUNTS OF GOLD FROM WATERS,
W68-01124 02K

PHYSICAL-CHEMICAL PROPERTIES OF NATURALLY OCCURRING POLYELECTROLYTES--(PART) 1, SODIUM HUMATE,
W68-01253 02K

U S GEOLOGICAL SURVEY, WATER RESOURCES DIVISION, DENVER.
EXAMPLES OF RECENT ADVANCES IN ANALYTICAL TECHNIQUES FOR EVALUATING AQUIFERS,
W68-01118 07A

U S GEOLOGICAL SURVEY.
ELECTRICAL-ANALOG ANALYSIS OF GROUND-WATER DEPLETION IN CENTRAL ARIZONA,
W68-01034 04B

GROUND-WATER RESOURCES OF UPTON COUNTY, TEXAS,
W68-01036 04B

FRESH AND SALINE GROUND-WATER ZONES IN THE PUNJAB REGION, WEST PAKISTAN,
W68-01039 03C

AVAILABILITY OF GROUND WATER IN THE OAKTON QUADRANGLE AND PART OF THE WOLF ISLAND QUADRANGLE IN JACKSON PURCHASE REGION, KENTUCKY,
W68-01117 04B

AVAILABILITY OF GROUND WATER IN THE HICKMAN QUADRANGLE, KENTUCKY-MISSOURI-TENNESSEE,
W68-01122 03B

SUMMARY OF THE GEOLOGY AND GROUND-WATER RESOURCES OF PITT COUNTY, NORTH CAROLINA,
W68-01147 04B

U S GEOLOGICAL SURVEY TRACER STUDY AMARGOSA DESERT, NYE COUNTY, NEVADA--PART I EXPLORATORY DRILLING, TRACER WELL CONSTRUCTION AND TESTING AND PRELIMINARY FINDINGS,
W68-01248 04B

DISSOLVED-MINERAL INFLOW TO GREAT SALT LAKE AND CHEMICAL CHARACTERISTICS OF THE SALT LAKE BRINE SUMMARY FOR WATER YEARS 1960, 1961, AND 1964,
W68-01249 02E

GROUND-WATER RESOURCES OF WOOD COUNTY, TEXAS,
W68-01250 04B

UNESCO COLLEGE OF ENGINEERING, RIYADH, SAUDI ARABIA.
THEORETICAL PREDICTION OF EVAPORATION LOSSES FROM GROUNDWATER,
W68-01172 02D

UNIVERSITY OF CALIFORNIA, DAVIS.
DEPTH OF DRAINAGE IN IRRIGATED AREAS,
W68-01231 04A

UNIVERSITY OF GRENOBLE, FRANCE.
THE USE OF SOIL MECHANICS METHODS FOR ADAPTING TOWER FOUNDATIONS TO SOIL CONDITIONS,
W68-01212 08D

UNIVERSITY OF UDAIPUR, INDIA CENTRAL ARID ZONE RESEARCH INSTITUTE, JODHPUR, INDIA.
RECLAMATION OF THE RAJPUTANA DESERT,
W68-01242 04A

UNIVERSITY OF WYOMING, LARAMIE.
REFRACTION DETERMINATION OF WATER TABLE DEPTH AND ALLUVIUM THICKNESS,
W68-01209 02F

USGS, WATER RESOURCES DIVISION, DENVER, COLORADO.
GEOGRAPHIC DISTRIBUTION AND FACTORS AFFECTING THE DISTRIBUTION OF SALT DESERT SHRUBS IN THE UNITED STATES,
W68-01176 02I

USGS, WATER RESOURCES DIVISION, MENLO PARK, CALIF.
WHAT IS DROUGHT,
W68-01100 02E

USSR ACADEMY OF SCIENCES, NOVOSIBIRSKI, INSTITUTE OF HYDRODYNAMICS, SIBERIAN BRANCH.
SPRING SLOPE RUNOFF FROM THE PRINCIPAL AGRICULTURAL LANDS OF THE KULUNDA STEPPE,
W68-01174 02C

UTAH STATE UNIV, WATER RESEARCH LAB, LOGAN.
ANALYSIS OF SUBMERGENCE IN FLOW MEASURING FLUMES,
W68-01123 08B

UTAH STATE UNIV., COLLEGE OF ENGINEERING, LOGAN.
GROUND WATER IN ECONOMIC DEVELOPMENT,
W68-01090 03F

UTAH STATE UNIV., LOGAN WATER RESEARCH LAB.
SUBCRITICAL FLOW OVER HIGHWAY EMBANKMENTS,
W68-01022 08B

UTAH STATE UNIV., LOGAN.
OPTIMIZING CONJUNCTIVE USE OF SURFACE WATER AND GROUNDWATER,
W68-01155 02A

UZBEKISTAN INSTITUTE OF SEISMOLOGY TASHKENT CENTRAL SEISMIC STATION, USSR.
THE TASHKENT EARTHQUAKE,
W68-01205 08E

U. S. ARMY COLD REGIONS RESEARCH AND ENGINEERING LAB., HANOVER, N. H.
NONSTEADY COMPRESSIBLE FLOW THROUGH ANISOTROPIC POROUS MEDIUMS WITH PARTICULAR REFERENCE TO SNOW,
W68-01128 02C

U. S. ARMY CORPS OF ENGINEERS, WASH., D. C., OFFICE OF CHIEF OF ENGINEERS.
CUCAMONGA CREEK, SAN BERNARDINO AND RIVERSIDE COUNTIES, CALIFORNIA (FLOOD CONTROL PROPOSAL).
W68-01033 06F

U. S. ARMY CORPS. OF ENGINEERS, WASH., D. C., OFFICE OF CHIEF OF ENGINEERS.
RED RIVER BELOW DENISON DAM, LOUISIANA, ARKANSAS, OKLAHOMA AND TEXAS.
W68-01032 06B

U. S. BUREAU OF RECLAMATION, DENVER, COLO.
INTERIM APPRAISAL OF OKLAHOMA BASINS PROJECT, OKLAHOMA WATER--THE KEY TO OKLAHOMA'S FUTURE.
W68-01131 06B

U. S. BUREAU OF RECLAMATION, SACRAMENTO, CALIF.
LAND SUBSIDENCE ALONG THE DELTA-MENDOTA CANAL, CALIFORNIA,
W68-01127 08A

U. S. BUREAU OF RECLAMATION.
PROGRESS REPORT ON WEST TEXAS AND EASTERN NEW MEXICO IMPORT PROJECT INVESTIGATION.
W68-01271 03F

U. S. DEPARTMENT OF AGRICULTURE, AGR RES SERV.
DYNAMICALLY SIMILAR MOTION OF TWO MISCIBLE CONSTITUENTS IN POROUS MEDIUMS,
W68-01031 02G

U. S. DEPARTMENT OF THE INTERIOR, WASHINGTON, D. C.
A STUDY IN THE ECONOMICS OF WATER QUALITY MANAGEMENT,
W68-01165 05G

U. S. DEPT OF AGRICULTURE, ECONOMIC RESEARCH SERVICE, WASH, D C.
THE CURRENT FEDERAL PROGRAM FOR RIVER BASIN PLANNING AND THE NEED FOR ECONOMIC ANALYSIS,
W68-01113 06B

U. S. DEPT. OF AGRICULTURE, MANHATTAN, KANSAS. AGRICULTURAL RESEARCH SERVICE.
A MONTHLY CLIMATIC FACTOR FOR THE WIND EROSION EQUATION,
W68-01086 02G

U. S. DEPT. OF AGRICULTURE, RIVERSIDE, CALIF. AGRICULTURAL RESEARCH SERVICE.
EFFECT OF SOIL SALINITY ON WATER POTENTIALS AND TRANSPIRATION IN PEPPER (CAPSICUM FRUTESCENS),
W68-01072 03F

U. S. DEPT. OF AGRICULTURE, TUCSON AGRICULTURAL RESEARCH SERVICE.
HYDROGRAPHS OF EPHEMERAL STREAMS IN THE SOUTHWEST,
W68-01092 04A

U. S. DEPT. OF AGRICULTURE, URBANA ILLINOIS STATE WATER SURVEY, CHAMPAIGN ILLINOIS UNIV., URBANA.
SOURCES OF ERROR IN CALCULATING THE KINETIC ENERGY OF RAINFALL,
W68-01089 02B

U. S. DEPT. OF AGRICULTURE, WESLACO, TEX. AGRICULTURAL RESEARCH SERVICE.
INFLUENCES OF PLANT MOISTURE STRESS, SOLAR RADIATION, AND AIR TEMPERATURE ON COTTON LEAF TEMPERATURE,
W68-01071 03F

U. S. DEPT. OF AGRICULTURE, WESLACO, TEX., AGRICULTURAL RESEARCH SERVICE.
RELATIVE TURGIDITY TECHNIQUE FOR SCHEDULING COTTON (GOSSYPIUM BIRSUTUM) IRRIGATION,

W68-01066 03F

U. S. GEOLOGICAL SURVEY, TUCSON, ARIZ.
VARIATIONS OF THE HYDRAULIC ROUGHNESS OF ALLUVIAL CHANNELS,
W68-01273 08B

U. S. GEOLOGICAL SURVEY, WASHINGTON, D. C.
AVERAGE PROBABILITY OF EXTREME EVENTS,
W68-01059 06F

U. S. GEOLOGICAL SURVEY, WATER RESOURCES DIV.
GEOLOGY AND GROUND WATER RESOURCES OF THE KALISPELL VALLEY, NORTHWESTERN MONTANA,
W68-01265 04B

GROUNDWATER FLOW AND THE GEOTHERMAL REGIME OF THE FLORIDIAN PLATEAU,
W68-01270 02F

U. S. GEOLOGICAL SURVEY, WATER RESOURCES DIV., MENLO PARK, CALIF.
CHEMICAL GEOHYDROLOGY,
W68-01263 02K

U. S. GEOLOGICAL SURVEY.
MAGNITUDE AND FREQUENCY OF FLOODS IN THE UNITED STATES PART 5. HUDSON BAY AND UPPER MISSISSIPPI RIVER BASIN,
W68-01023 02E

GROUND-WATER RESOURCES OF CHOWAN COUNTY, NORTH CAROLINA,
W68-01024 04B

WATER DATA FOR METROPOLITAN AREAS,
W68-01027 07A

GROUNDWATER CONDITIONS IN THE WATERMAN WASH AREA, MARICOPA AND PINAL COUNTIES, ARIZONA,
W68-01028 04B

STREAMS IN DUTCHESS COUNTY, NEW YORK--THEIR FLOW CHARACTERISTICS AND WATER QUALITY IN RELATION TO WATER PROBLEMS,
W68-01042 04A

EVAPOTRANSPIRATION AND THE WATER BUDGET OF PRAIRIE POTHOLES IN NORTH DAKOTA,
W68-01043 02D

DETERMINATION OF MOLYBDENUM IN FRESH WATERS - A COMPARISON OF METHODS,
W68-01046 02K

FLOW PATTERN AND RELATED CHEMICAL QUALITY OF GROUND WATER IN THE '500-FOOT' SAND IN THE MEMPHIS AREA, TENNESSEE,
W68-01130 02F

AVAILABILITY OF GROUND WATER IN THE PARTS OF THE WICKLIFFE AND WICKLIFFE NW QUADRANGLES IN JACKSON PURCHASE REGION, KENTUCKY,
W68-01132 04B

FLOOD OF MARCH 24, 1967, KIHEI AND OLOWALU AREAS, ISLAND OF MAUI, HAWAII,
W68-01133 02E

AVAILABILITY OF GROUND WATER IN PARTS OF THE CAIRO AND BARLOW QUADRANGLES IN THE JACKSON PURCHASE REGION, KENTUCKY,
W68-01134 04B

HYDROLOGIC AND CLIMATOLOGIC DATA, 1967, SALT LAKE COUNTY, UTAH,
W68-01135 02A

GENERAL PROCEDURE FOR GAGING STREAMS,
W68-01138 07A

SCOUR AND FILL IN ALLUVIAL CHANNELS WITH PARTICULAR REFERENCE TO BRIDGE SITES,
W68-01139 08A

GROUND-WATER RESOURCES OF THE APPALACHIAN REGION,
W68-01140 03B

POTENTIAL APPLICATIONS OF NUCLEAR EXPLOSIVES IN DEVELOPMENT AND MANAGEMENT OF WATER RESOURCES--PRELIMINARY CANVASS OF THE GROUND-WATER ENVIRONMENT,
W68-01142 08H

GEOLOGY AND GROUND-WATER RESOURCES OF THE LOWER BIGHORN VALLEY, MONTANA,
W68-01144 04B

METHODS FOR PREDICTING DISPERSION COEFFICIENTS IN NATURAL STREAMS, WITH APPLICATIONS TO LOWER REACHES OF THE GREEN AND DUWAMISH RIVERS, WASH.,
W68-01145 02E

SELECTED HYDROLOGIC DATA, SAN PITCH RIVER DRAINAGE BASIN, UTAH,
W68-01146 03B

GROUND-WATER LEVELS IN NEW MEXICO, 1966,
W68-01266 04B

GEOLOGY AND WATER RESOURCES OF THE HIBBING AREA, NORTHEASTERN MINNESOTA,
W68-01267 04B

FLOODS IN THE MAYAGUEZ AREA OF PUERTIO RICO,
W68-01272 03B

U.S. CONGRESS, SENATE COMM. ON PUBLIC WORKS.
HEARINGS ON S4 BEFORE A SPECIAL SUBCOMMITTEE ON AIR AND WATER POLLUTION OF THE COMMITTEE ON PUBLIC WORKS, UNITED STATES SENATE.
W68-01369 05G

VANDERBILT UNIV., NASHVILLE, TENN. AND JOHNS HOPKINS UNIV., BALTIMORE, MD.
ANALYZING STEAM ELECTRIC POWER PLANT DISCHARGES,
W68-01026 05B

WASHINGTON UNIV, ST. LOUIS.
A SHORT COURSE ON WATER LAW FOR THE EASTERN UNITED STATES,
W68-01368 06E

WASHINGTON UNIV., SEATTLE CALIFORNIA UNIV., BERKELEY.
A SOCIALLY OPTIMUM PRICING POLICY FOR A PUBLIC WATER AGENCY,
W68-01057 06C

WATER RESOURCES COUNCIL, WASH, D C.
THE IMPORTANCE OF RESEARCH AND PLANNING IN WATER RESOURCE DEVELOPMENT,
W68-01114 06B

WESTINGHOUSE ELECTRIC CORP., EAST PITTSBURGH, PA.
1100-KV STATION AND LINE INSULATION DESIGN,
W68-01214 08C

WISCONSIN NATURAL RESOURCES DEPARTMENT.
MANIPULATION OF RESERVOIR WATER FOR IMPROVED QUALITY AND FISH POPULATION RESPONSE.
W68-01143 05C

WISCONSIN UNIV. MADISON.
ADSORPTION CATALYZED CHEMICAL HYDROLYSIS OF ATRAZINE,
W68-01246 03F

WOODS HOLE OCEANOGRAPHIC INST.
A FLEXIBLE COMPUTER PROGRAM FOR EVALUATION OF EMISSION SPECTROMETRIC DATA,
W68-01252 07C

WYOMING UNIV SCHOOL OF LAW, LARAMIE.
POLICIES FOR WATER LAW PROPERTY RIGHTS, ECONOMIC FORCES, AND PUBLIC REGULATION,
W68-01312 06B

W68-01313 06B

WYOMING UNIV., LARAMIE.
THE EFFECTS OF VARYING LAND AND WATER USE ON STREAMFLOW REGIMEN,
W68-01261 04C

ACCESSION NUMBER INDEX

05D	W68-01020
07B	W68-01021
08B	W68-01022
02F	W68-01023
04B	W68-01024
05B	W68-01026
07A	W68-01027
04B	W68-01028
02C	W68-01029
08B	W68-01030
02G	W68-01031
06B	W68-01032
06F	W68-01033
04B	W68-01034
02C	W68-01035
04B	W68-01036
04A	W68-01037
08B	W68-01038
03C	W68-01039
08B	W68-01040
02C	W68-01041
04A	W68-01042
02D	W68-01043
02F	W68-01044
02K	W68-01046
02F	W68-01047
05D	W68-01048
05A	W68-01049
06C	W68-01050
05G	W68-01051
06F	W68-01052
06D	W68-01053
06B	W68-01054
06B	W68-01055
06B	W68-01056
06C	W68-01057
06B	W68-01058
06F	W68-01059
06C	W68-01060
06C	W68-01061
06F	W68-01062
06B	W68-01063
06F	W68-01064
06B	W68-01065
03F	W68-01066
03F	W68-01067
03F	W68-01068
02I	W68-01069
02G	W68-01070
03F	W68-01071
03F	W68-01072
05C	W68-01073
03F	W68-01074
03F	W68-01075
02D	W68-01076
02D	W68-01077
02I	W68-01078
03F	W68-01079
04B	W68-01080
02I	W68-01081
02H	W68-01082
04B	W68-01083
04B	W68-01084
04B	W68-01085
02G	W68-01086
03F	W68-01087
02B	W68-01089
03F	W68-01090
03C	W68-01091
04A	W68-01092
02H	W68-01093
03B	W68-01094
03C	W68-01095
06F	W68-01096
03F	W68-01097
02G	W68-01098
03F	W68-01099
02F	W68-01100
03F	W68-01101
06G	W68-01102
03F	W68-01103
03F	W68-01104
04D	W68-01105
03F	W68-01106
02I	W68-01107
02K	W68-01108
02D	W68-01109
06A	W68-01110
06B	W68-01111
06D	W68-01112
06B	W68-01113
06B	W68-01114
06B	W68-01115
07B	W68-01116
04B	W68-01117
07A	W68-01118
02A	W68-01119
02G	W68-01120
04D	W68-01121
03B	W68-01122
08B	W68-01123
02K	W68-01124
05D	W68-01125
03A	W68-01126
08A	W68-01127
02C	W68-01128
08B	W68-01129
02F	W68-01130
06B	W68-01131
04B	W68-01132
02F	W68-01133
04B	W68-01134
02A	W68-01135
02G	W68-01136
03B	W68-01137
07A	W68-01138
08A	W68-01139
03B	W68-01140
03B	W68-01141
08H	W68-01142
05C	W68-01143
04B	W68-01144
02F	W68-01145
03B	W68-01146
04B	W68-01147
03C	W68-01148
05F	W68-01149
08C	W68-01150
08A	W68-01151
06A	W68-01152
06A	W68-01153
06A	W68-01154
02A	W68-01155
04B	W68-01156
06B	W68-01157
06A	W68-01158
05G	W68-01159
06A	W68-01160
05D	W68-01161
05G	W68-01162
06A	W68-01163
03F	W68-01164
05G	W68-01165
06A	W68-01166
05G	W68-01167
05D	W68-01168
02J	W68-01169
02I	W68-01170
02B	W68-01171
02D	W68-01172
02G	W68-01173
02C	W68-01174
02G	W68-01175
02I	W68-01176
03C	W68-01177
08D	W68-01178
08D	W68-01179
02B	W68-01180
03B	W68-01181
06B	W68-01182
06C	W68-01183
06D	W68-01184
06B	W68-01185
02F	W68-01186
03F	W68-01187
03F	W68-01188
03F	W68-01189
03F	W68-01190
05G	W68-01191
03F	W68-01192
03D	W68-01193
08G	W68-01194
08D	W68-01195
08H	W68-01196
08H	W68-01197
08D	W68-01198
08A	W68-01199
07A	W68-01200
08A	W68-01201
08D	W68-01202
08G	W68-01203
07C	W68-01204
08F	W68-01205
06G	W68-01206
08D	W68-01207
08D	W68-01208
02F	W68-01209
08F	W68-01210
08C	W68-01211
08D	W68-01212
08C	W68-01213
08C	W68-01214
08C	W68-01215
08C	W68-01216
08C	W68-01217
08C	W68-01218
08C	W68-01219
08F	W68-01220
08B	W68-01221
08A	W68-01222
08F	W68-01223
08F	W68-01224
08C	W68-01225
08B	W68-01226
02F	W68-01227
08A	W68-01228
08C	W68-01229
08B	W68-01230
04A	W68-01231
03B	W68-01232
02F	W68-01233
03F	W68-01234
04A	W68-01235
08B	W68-01236
02F	W68-01237
07B	W68-01238
07B	W68-01239
07B	W68-01240
07B	W68-01241
04A	W68-01242
05C	W68-01244
05G	W68-01245
03F	W68-01246
02J	W68-01247
04B	W68-01248
02F	W68-01249
04B	W68-01250
02B	W68-01251
07C	W68-01252
02K	W68-01253
02B	W68-01254
05B	W68-01255
03D	W68-01257
08B	W68-01258
02A	W68-01259
02A	W68-01260
04C	W68-01261
02L	W68-01262
02K	W68-01263
02C	W68-01264
04B	W68-01265
04B	W68-01266
04B	W68-01267
02L	W68-01268
05C	W68-01269
02F	W68-01270
03F	W68-01271
03B	W68-01272
08B	W68-01273
05B	W68-01274
05A	W68-01275
05A	W68-01276
04A	W68-01277
04A	W68-01278
04A	W68-01279
04A	W68-01280
05A	W68-01281
05B	W68-01282
04A	W68-01283
04A	W68-01284
06F	W68-01285
06F	W68-01286
06F	W68-01287
06F	W68-01288
06F	W68-01289
06F	W68-01290
06F	W68-01291
06F	W68-01292
06F	W68-01293
06F	W68-01294
06F	W68-01295
06F	W68-01296
06F	W68-01297
06F	W68-01298
06F	W68-01299
06F	W68-01300
06F	W68-01301
05G	W68-01302
04A	W68-01303
05G	W68-01304
05C	W68-01305
06F	W68-01306
06B	W68-01307
06D	W68-01308
06D	W68-01309
06B	W68-01310
06B	W68-01311
06B	W68-01312
06B	W68-01313
06F	W68-01314
06F	W68-01315
06F	W68-01316
03B	W68-01317
06D	W68-01318
06B	W68-01319
06F	W68-01320
05G	W68-01321
05F	W68-01322
03A	W68-01323
06F	W68-01324

04D	W68-01325	04A	W68-01346	06F	W68-01366	06F	W68-01386
04D	W68-01326	06E	W68-01347	03B	W68-01367	03B	W68-01387
04D	W68-01327	06F	W68-01348	06E	W68-01368	03D	W68-01388
06E	W68-01328	06E	W68-01349	05G	W68-01369	06F	W68-01389
04C	W68-01329	06E	W68-01350	05G	W68-01370	06F	W68-01390
04C	W68-01330	06F	W68-01351	06D	W68-01371		
06B	W68-01332	06F	W68-01352	06E	W68-01372	06F	W68-01391
06F	W68-01333	06F	W68-01353	06E	W68-01373	05G	W68-01392
04C	W68-01334	06F	W68-01354	03D	W68-01374	06E	W68-01393
04C	W68-01335	06F	W68-01355	06F	W68-01375	06E	W68-01394
04C	W68-01336	06C	W68-01356	06E	W68-01376	06F	W68-01395
06F	W68-01337	06E	W68-01357	06E	W68-01377	03F	W68-01396
06F	W68-01338	06E	W68-01358	04D	W68-01378	06D	W68-01397
04C	W68-01339	05G	W68-01359	06E	W68-01379		
06F	W68-01340	05G	W68-01360	05E	W68-01380	06F	W68-01398
06B	W68-01341	06F	W68-01361	06F	W68-01381	06C	W68-01399
06F	W68-01342	06F	W68-01362	06D	W68-01382	06C	W68-01400
06B	W68-01343	06F	W68-01363	06C	W68-01383	06F	W68-01401
06D	W68-01344	06F	W68-01364	06F	W68-01384	06D	W68-01402
03F	W68-01345	06E	W68-01365	06E	W68-01385	03B	W68-02256

★ U.S. GOVERNMENT PRINTING OFFICE : 1968 OL—326-168

Subject Fields

1 NATURE OF WATER

2 WATER CYCLE

3 WATER SUPPLY AUGMENTATION AND CONSERVATION

4 WATER QUANTITY MANAGEMENT AND CONTROL

5 WATER QUALITY MANAGEMENT AND PROTECTION

6 WATER RESOURCES PLANNING

7 RESOURCES DATA

8 ENGINEERING WORKS

9 MANPOWER, GRANTS, AND FACILITIES

0 SCIENTIFIC AND TECHNICAL INFORMATION

INDEXES

SUBJECT INDEX

AUTHOR INDEX

ORGANIZATIONAL INDEX

ACCESSION NUMBER INDEX

POSTAGE AND FEES PAID
U.S. DEPARTMENT OF COMMERCE

LIBRARY RATE
PRINTED MATTER

U.S. DEPARTMENT OF COMMERCE
CLEARINGHOUSE FOR FEDERAL
SCIENTIFIC AND TECHNICAL INFORMATION
SPRINGFIELD, VA. 22151

OFFICIAL BUSINESS